Bridgeport

Hand Book for Architects Engineers and Superintendents

Bridgeport Brass Co
Bridgeport Conn U S A

Seamless Tubing

Hand Book

for Architects Engineers and Superintendents

With Conveniently Arranged Tables and Prices for

Seamless

Brass and Copper

Tubing

"Bridgeport"

TRADE BRASS CO. MARK U.S.A. U.S.A.

Bridgeport, Connecticut

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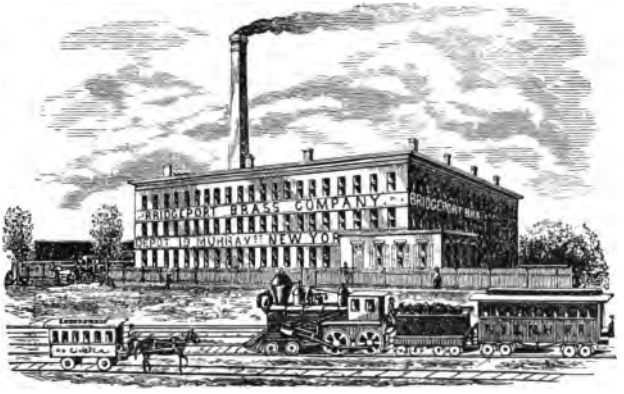
Seamless Brass and Copper Tube, Rod and Rolling Mill



Bridgeport Brass Company Factory in 1865

[Reprint from an Old Wood Cut]

THE Bridgeport Brass Company is one of the pioneer makers of Seamless Tubing in this Country, having been actively identified with the industry for over thirty years. To an unusual extent the processes employed in the manufacture of this product demand for their successful execution a quality of knowledge obtainable only as the result of a long period of accumulated practice.

While we have for years devoted time and money to the scientific study of the natural laws and principles underlying the art of tube making, it is through long and wide experience that we have learned the proper practice of the art itself. This experience is of especial value in enabling us to satisfactorily meet the great variety of requirements encountered in the many uses to which tubes are put.

It is with entire confidence, therefore, that we solicit your orders for Copper and Copper Alloy Seamless Tubing for any and all purposes, including those for which exceptional conditions call for unusual qualities.

We are equipped to give our customers all the assistance which a perfect plant and a mastery of the science and technic of tube making can supply.

Interior of a Section of the "Bridgeport" Seamless Tube Mill

Additions to Tube Mill, Under Construction

Methods of Manufacturing "Bridgeport" Seamless Brass and Copper Tubing

Pure metals are prime factors in making perfect seamless Tubing. We use pure metals only, which is one reason for the high quality of the "Bridgeport" product.

We have our own testing laboratories to safeguard this quality. As we work in strict accord with invariable formulas and methods, the use of pure metals assures for us the greatest economy and expedition in manufacturing.

There are four principle methods for making Seamless Tubes of copper or copper alloys:

1. The Cupping Process
2. The Extrusion Process
3. The Mannesmann Process
4. The Cast Shell Process

The Cupping Process

By this method, a flat casting is first made and this is rolled down to a sheet of required thickness. Out of this sheet, a circular blank is stamped. The blank is then "cupped up" on a press.

By successive cold drawings over steel arbors and through hardened steel dies, each reducing the diameter and thickness of the tube, the required size and gauge is finally reached. The cupping process is used for

"Bridgeport" Seamless Tubes Stacked for Inspection

Annealing and Pickling

making tubes of very large diameter and of comparatively short lengths. It is used also for making tubes of very thin gauge and small diameter.

The Extrusion Process

A cylindrical billet is cast. This is heated to a plastic temperature and by hydraulic pressure forced out through a die, over a steel mandrel. The tube thus formed is then cold drawn, over steel triblets or arbors and through hardened steel dies.

The Mannesmann Process

This process was named for Reinhard Mannesmann, a German engineer, who accidentally discovered that the cross-rolling of a heated round bar produced a rupture through its center with a tendency to form a hole along the longitudinal axis. This process, and modifications of it, have been used largely in the manufacture of brass and copper tubing; but its use is limited to certain mixtures which can be worked hot. After being rolled on the Mannesmann machine the tube must be pointed and cold drawn to required size.

The Cast Shell Process

A cylindrical shell of suitable length is cast in an iron mould over a core. It is then annealed, pickled and cold drawn. By this method Tubes can be made from practically all ductile alloys.

Seamless Brass and Copper Tube, Rod and Rolling Mill, Showing Water Frontage

Annealing and Pickling

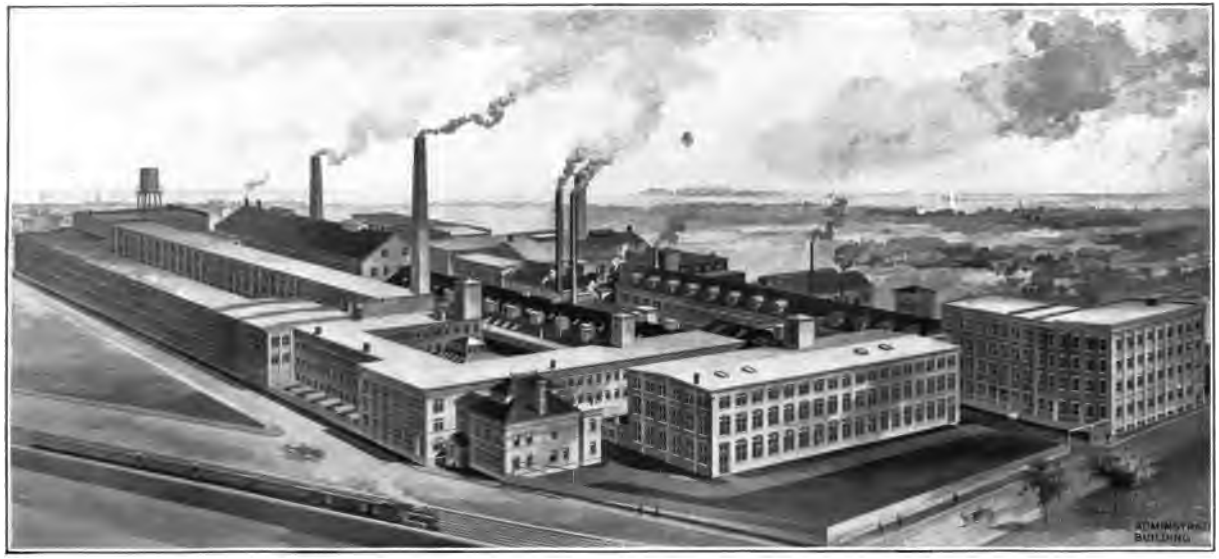
Every Bridgeport Seamless Drawn tube is cold drawn from six to eighteen times depending upon the guage. Between each drawing, it is necessary to anneal and pickle the tubes. For these operations which require extreme care, we have special equipments that have been developed as a result of prolonged experiments.

Special Heat Treatment

There are certain requirements, such as those occurring in the use of tubes for surface condensers, for which, in order to assure the most satisfactory service, we include in our process of manufacture a special method of heat treatment. The furnaces for this purpose are of our own construction and permit an accurate measurement and control of temperature. We have given this subject very careful study and with our special equipment have been able to attain for Bridgeport Tubes a Service Quality unequalled by tubes made by processes ordinarily considered standard.

One important result of this special treatment is that Bridgeport Seamless Tubes are less susceptible to dezincification than those manufactured by other methods.

Every Tube tested to Withstand 1000 lbs. Internal Water Pressure



Rolling and Wire Mill, and Plant for Manufacturing

In the Chemical Laboratory

Exact Methods of Manufacture

The aim, in the industrial world to-day, is to standardize products and to eliminate guess-work in all manufacturing processes.

Not so very long ago the brass expert determined the composition of a copper alloy by scraping it with a tool and noting color and hardness. And he guided his mixing, casting, drawing, annealing and other operations by equally uncertain "rule of thumb" methods.

The modern way—the way of the Bridgeport Brass Company—is to do everything by exact methods, in accord with the highest efficiency ideals.

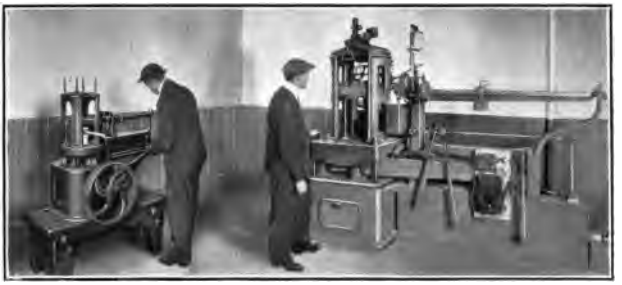
Everything is Done by Exact Methods

Melting Small Charges of Metal

The Company maintains fully equipped chemical, physical and metallurgical laboratories. Every lot of crude metal is tested before it goes to the melting pot. Every alloy is pre-determined by analysis and exhaustively tested for its purpose. Once determined upon, the standard never varies.

The laboratory is equipped with electrical furnaces for melting small charges of metal. By means of these little furnaces castings are made as successfully as when the large crucibles are used. These sample castings are annealed in a laboratory muffle, and their physical characteristics are then revealed by the testing machine, the scleroscope and by photo-micrographs.

Making Photo-Micrographs



In the Physical Laboratory

Thus in all cases where tubing or other Copper Alloy products are to be made for special purposes, the ideals are attained in the laboratory and are then systematically worked out in the various departments.

Guarantee

By the use of pure metals for all alloys, by exact methods for controlling every operation of manufacture and by the final safeguard of systematic inspections and tests, an unexcelled standard is maintained for "Bridgeport" Seamless Tubing.

The Company will cheerfully replace any stock proving defective.

Samples Tested by Slitting and Twisting

Corner of Pump Room

Data Required to Insure the Prompt Execution of Orders

We shall always be able to fill your orders promptly and satisfactorly if you will tell us exactly what is wanted—especially as to the following particulars:

1. Purpose: As Seamless Tube is used for a great variety of purposes and under widely varying conditions, which can best be met by particular combinations of mixture and treatment, it is essential that we should know exactly for what purpose any lot of tubing is to be used, whether for Condensers, Evaporators, Plumbing work, Bearings or for other purposes.

2. Material: Always state the kind of tubing required; Brass, Bronze, Copper or Admiralty Mixture.

3. Diameter: Specify inside or outside diameter. When either is important, specify diameter in the decimal parts of inch, as ascertained by micrometer calipers.

When ordering tubes which are intended to sleeve together ***the Smaller Tube should be ordered to the outside diameter*** with instructions "to be sliding fit into the sleeve" and ***the Sleeve or Larger Tube should be ordered to inside diameter*** with instructions" to slide over the tube." Samples should be sent if possible.

4. Gauge: As the greater part of our stock regularly kept on hand is in Stubb's Gauge, more prompt delivery can be made if tubing is so ordered. See Pages 26 to 29 for tables showing sizes and weights.

5. Iron Pipe Sizes: When ordering Iron Pipe Sizes, state if ***ordinary*** or ***extra heavy*** tubing is required. (See Pages 37, 38.)

6. Length: Quicker delivery can always be made of regular mill lengths, than of tubes cut to specific lengths, because a much larger stock is available. Unless otherwise ordered the mill lengths will be sent.

7. Temper: The following classifications of Tempers are sufficient for ordinary purposes:—

Brass

Hard: For purposes where the utmost stiffness and rigidity are required.

Half-Hard: For purposes requiring a certain degree of stiffness with quality to withstand moderate distortion or change of shape. This temper is obtained by a medium amount of drawing from the soft condition.

Semi-Annealed: For purposes requiring an annealed tube with a maximum degree of stiffness. This temper is obtained by partially annealing a hard tube.

Soft: For purposes requiring bending, flanging or other distortion.

Copper

Hard: This is the usual temper for copper tubes. It is not suitable for tubes that are to be bent.

Half-Hard: Sometimes furnished on receipt of specific information as to use.

Annealed or Soft: For uses where much bending or distortion is required.

Corner of Engine Room, Showing Various Apparatus

The following are a few "Bridgeport" Products:

Seamless Brass and Copper Tubing for all purposes, including Seamless Condenser Tubing in Brass and Admirality Mixtures, plain and tinned.

Automobile Wind Shields and Step Mouldings and other odd shapes for special purposes.

Brass and Copper Rods, Round, Square, or Rectangular.

Rods in **"Bridgeport"** Bronze, Manganese Bronze, Aluminum Bronze, Phosphor Bronze, Silicon Bronze.

Brass, Copper and German Silver in sheets.

"Phono-Electric" Trolley and Telephone Wire.

Miscellaneous Manufactured Goods, in Brass, Copper, Bronze and German Silver; also Copper Rivets and Brass Lamps, Bicycle Lanterns, etc.

We are particularly fitted, by Experience and Equipment, to produce Drawn, Stamped and Special Shapes from Brass, Copper, Bronze and German Silver in Sheet, Tube, Rod and Wire. We make the article from the ingot to the finished product.

Send us Specifications, Blue Print or Sample of your work and we will promptly send estimate of price.

Bridgeport Brass Company
Bridgeport, Connecticut, U. S. A.
New York Office: 253 Broadway, Cor. Murray St.

Data and Prices

for Architects
Engineers
Superintendents
and all Users of

Seamless Tubing

[See Index Pages 4 to 9]

"Bridgeport"

BRASS CO.

TRADE MARK

U.S.A. U.S.A.

TABLE SHOWING WEIGHT PER FOOT OF

Stub's or Birmingham Gauge,

Gauge No.	3	4	5	6	7	8	9	10	11	12	13	14
Thickness of each No. in decimal parts of inch :	.259	.238	.220	.203	.180	.165	.148	.134	.120	.109	.095	.083
Frac. of inch, orresponding closely to Gauge Nos.:	1/4	15/64	.....	13/64	9/16	11/64	9/64	....	1/8	.....	3/32	5/64
Diameter Tubes, Inches.												
1/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1/4	.....	.....	.....	.....	.....	.....	.....	.....	.18	.177	.170	.160
5/16	.....	.....	.....	.....	.....	.....	.....	.....	.27	.256	.238	.220
3/8	.....	.....	.....	.....	.....	.40	.39	.37	.35	.335	.307	.280
7/16	.....	.....	.....	.....	.....	.52	.49	.47	.44	.413	.376	.340
1/2	.....	.....	.....	.70	.66	.64	.60	.57	.53	.492	.444	.400
9/16	.....	.....	.....	.84	.79	.76	.71	.66	.61	.571	.513	.460
5/8	1.09	1.06	1.03	.99	.92	.88	.81	.76	.70	.649	.581	.520
11/16	1.28	1.23	1.19	1.13	1.05	.99	.92	.86	.79	.728	.650	.580
3/4	1.47	1.41	1.35	1.28	1.18	1.11	1.03	.95	.87	.807	.718	.640
13/16	1.65	1.58	1.50	1.43	1.31	1.23	1.13	1.05	.96	.885	.787	.700
7/8	1.84	1.75	1.66	1.57	1.44	1.35	1.24	1.15	1.04	.964	.855	.759
15/16	2.03	1.92	1.82	1.72	1.57	1.47	1.35	1.24	1.13	1.042	.924	.819
1	2.22	2.09	1.98	1.87	1.70	1.59	1.45	1.34	1.22	1.12	.99	.88
1 1/16	2.60	2.44	2.30	2.16	1.96	1.83	1.67	1.53	1.39	1.28	1.13	1.00
1 1/8	2.97	2.78	2.61	2.45	2.22	2.07	1.88	1.73	1.56	1.44	1.27	1.12
1 3/16	3.35	3.12	2.93	2.75	2.48	2.30	2.10	1.92	1.74	1.59	1 40	1.24
1 1/4	3.72	3.47	3.25	3.04	2.74	2.54	2.31	2.11	1.91	1.75	1.54	1.36
1 5/16	4.09	3.81	3.57	3.33	3.00	2.78	2.52	2.31	2.08	1.91	1.68	1.48
1 3/4	4.47	4.15	3.88	3.62	3.26	3.02	2.74	2.50	2.26	2.06	1.82	1.60
1 7/8	4.84	4.50	4.20	3.92	3.52	3.26	2.95	2.69	2.43	2.22	1.95	1.72
2	5.21	4.84	4.52	4.21	3.78	3.50	3.16	2.89	2.60	2.38	2.09	1.84
2 1/16	5.59	5.18	4.84	4.50	4.04	3.73	3.38	3.08	2.78	2.54	2.23	1.96
2 1/8	5.96	5.53	5.15	4.80	4.30	3.97	3.59	3.27	2.95	2.69	2.36	2.08
2 3/16	6.34	5.87	5.47	5.09	4.56	4.21	3.80	3.47	3.12	2.85	2.50	2.20
2 1/4	6.71	6.21	5.79	5.38	4.82	4.45	4.02	3.66	3.30	3.01	2.64	2.32
2 5/16	7.08	6.56	6.11	5.67	5.08	4.69	4.23	3.85	3.47	3.17	2.77	2.44
2 3/4	7.46	6.90	6.42	5.97	5.34	4.92	4.44	4.05	3.64	3.32	2.91	2.56
2 7/8	7.83	7.24	6.74	6.26	5.60	5.16	4.66	4.24	3.81	3.48	3.05	2.68
3	8.20	7.59	7.06	6.55	5.86	5.40	4.87	4.43	3.99	3.64	3.19	2.79
3 1/16	8.58	7.93	7.38	6.85	6.12	5.64	5.08	4.63	4.16	3.79	3.32	2.91
3 1/4	8.95	8.27	7.69	7.14	6.38	5.88	5.30	4.82	4.33	3.95	3.46	3.03
3 3/8	9.33	8.62	8.01	7.43	6.64	6.11	5.51	5.01	4.51	4.11	3.60	3.15
3 1/2	9.70	8.96	8.33	7.72	6.90	6.35	5.72	5.21	4.68	4.27	3.73	3.27
3 5/8	10.07	9.30	8.65	8.02	7.16	6.59	5.94	5.40	4.85	4.42	3.87	3.39
3 3/4	10.45	9.65	8.96	8.31	7.42	6.83	6.15	5.59	5.03	4.58	4.01	3.51
3 7/8	10.82	9.99	9.28	8.60	7.68	7.07	6.37	5.79	5.20	4.74	4.15	3.63

To determine weight per foot of a tube of a given Inside below under corre-

Gauge No.	3	4	5	6	7	8	9	10	11	12	13	14
Increase in lbs. per foot :	1.5487	1.3077	1.1174	.9514	.7480	.6285	.5057	.4145	.3324	.2743	.2084	.1590

"BRIDGEPORT" SEAMLESS BRASS TUBES

Measured in **Outside Diameters**

Gauge No.	15	16	17	18	19	20	21	22	23	24	25	26	27
Thickness of each No. in decimal parts of inch :	.072	.065	.058	.049	.042	.035	.032	.028	.025	.022	.020	.018	.016
Frac. of inch, corresponding closely to Gauge Nos.:	....	1/16	....	3/64	....	.....	1/32	.....	.....	....	....	....	1/64
Diameter Tubes, Inches.													
1/8	....	.045	.045	.043	040	.036	.034	.031	.029	.026	.024	.022	.020
3/16	.096	.092	.087	.078	.070	.062	.057	.051	.047	.042	.039	.035	.032
1/4	.148	.139	.129	.114	.101	.087	.080	.072	.065	.058	.053	.048	.043
5/16	.200	.186	.170	.149	.131	.112	.104	.092	.083	.074	.067	.061	.055
3/8	.252	.233	.212	.184	.161	.137	.127	.112	.101	.090	.082	.074	.066
7/16	.304	.279	.254	.220	.192	.163	.150	.132	.119	.106	.096	.087	.078
1/2	.356	.326	.296	.255	.222	.188	.173	.152	.137	.121	.111	.100	.089
9/16	.408	.373	.338	.290	.252	.213	.196	.173	.155	.137	.125	.113	.101
5/8	.460	.420	.380	.326	.283	.238	.219	.193	.173	.153	.140	.126	.112
11/16	.511	.467	.421	.361	.313	.264	.242	.213	.191	.169	.154	.139	.124
3/4	.563	.514	.463	.396	.343	.289	.265	.233	.209	.185	.169	.152	.136
13/16	.615	.561	.505	.432	.373	.314	.288	.253	.227	.201	.183	.165	.148
7/8	.667	.608	.547	.467	.404	.339	.311	.274	.245	.217	.197	.178	.159
15/16	.719	.655	.589	.502	.434	.365	.334	.294	.263	.232	.211	.191	.171
1	.77	.70	.63	.54	.46	.389	.358	.314	.281	.248	.226	.204	.182
1 1/8	.87	.79	.71	.61	.52	.439	.404	.354	.317	.280	.255	.230	.205
1 1/4	.98	.89	.80	.68	.59	.490	.450	.395	.354	.312	.284	.256	.228
1 3/8	1.08	.98	.88	.75	.65	.540	.496	.435	.390	.343	.313	.282	.251
1 1/2	1.19	1.08	.96	.82	.71	.591	.542	.476	.426	.375	.342	.308	.274
1 5/8	1.29	1.17	1.05	.89	.77	.641	.588	.516	.462	.407	.371	.334	....
1 3/4	1.39	1.26	1.13	.96	.83	.692	.635	.556	.498	.439	.399	.360	....
1 7/8	1.50	1.36	1.22	1.03	.89	.742	.681	.597	.534	.470	.428	.386	....
2	1.60	1.45	1.30	1.10	.95	.793	.727	.637	.570	.502	.457	.412	....
2 1/8	1.71	1.55	1.38	1.17	1.01	.843	.773	.678	.606	.534	.486	....	....
2 1/4	1.81	1.64	1.47	1.24	1.07	.894	.819	.718	.642	.566	.515	....	....
2 3/8	1.91	1.73	1.55	1.32	1.13	.944	.866	.758	.678	.597	.544	....	....
2 1/2	2.02	1.83	1.63	1.39	1.19	.995	.912	.799	.714	.629	.573	....	....
2 5/8	2.12	1.92	1.72	1.46	1.25	1.045	.958	.839	.750	.661	....	....	....
2 3/4	2.23	2.01	1.80	1.53	1.31	1.096	1.004	.880	.786	.693	....	....	....
2 7/8	2.33	2.11	1.89	1.60	1.37	1.146	1.050	.920	.822	.724	....	....	....
3	2.43	2.20	1.97	1.67	1.43	1.197	1.096	.960	.859	.756	....	....	....
3 1/8	2.54	2.30	2.05	1.74	1.49	1.247	1.143	1.001	.895	.788	....	....	....
3 1/4	2.64	2.39	2.14	1.81	1.55	1.298	1.189	1.041	.931	.820	....	....	....
3 3/8	2.74	2.48	2.22	1.88	1.62	1.348	1.235	1.082	.967	.851	....	....	....
3 1/2	2.85	2.58	2.30	1.95	1.68	1.399	1.281	1.122	1.003	.883	....	....	....
3 5/8	2.95	2.67	2.39	2.02	1.74	1.449	1.327	1.162	1.039	.915	....	....	....
3 3/4	3.06	2.76	2.47	2.09	1.80	1.50	1.373	1.203	1.075	.946	....	....	....
3 7/8	3.16	2.86	2.56	2.16	1.86	1.55	1.42	1.243	1.111	.978	....	....	....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	15	16	17	18	19	20	21	22	23	24	25	26	27
Increase in lbs. per foot:	.1197	.0975	.0777	.0554	.0407	.0283	.0236	.0181	.0144	.0112	.0092	.0075	.0059

TABLE SHOWING WEIGHT PER FOOT OF

Stub's or Birmingham Gauge,

Gauge No.	3	4	5	6	7	8	9	10	11	12
Thickness of each No. in decimal parts of inch:	.259	.238	.220	.203	.180	.165	.148	.134	.120	.109
Frac. of inch, corresponding closely to Gauge Nos.:	1/4	15/64	.....	13/64	9/16	11/64	9/64	.....	1/8	....
Diameter Tubes, Inches										
4	11.19	10.33	9.60	8.90	7.94	7.31	6.58	5.98	5.37	4.89
4⅛....	11.57	10.68	9.91	9.19	8.20	7.54	6.79	6.17	5.55	5 -5
4¼....	11.94	11.02	10.23	9.48	8.46	7.78	7.01	6.37	5.72	5.21
4⅜....	12.32	11.36	10.55	9.77	8.72	8.02	7.22	6.56	5.89	5.37
4½....	12.69	11.71	10.87	10.07	8.98	8.26	7.43	6.75	6.06	5.52
4⅝....	13.06	12.05	11.18	10.36	9.24	8.50	7.65	6.94	6.24	5.68
4¾....	13.44	12.39	11.50	10.65	9.50	8.73	7.86	7.14	6.41	5.84
4⅞....	13.81	12.74	11.82	10.95	9.76	8.97	8.07	7.33	6.58	6.00
5	14.18	13.08	12.14	11.24	10.02	9.21	8.29	7.53	6.76	6.15
5⅛....	14.56	13.42	12.45	11.53	10.28	9.45	8.50	7.72	6.93	6.31
5¼....	14.93	13.77	12.77	11.82	10.53	9.69	8.71	7.91	7.10	6.47
5⅜....	15.31	14.11	13.09	12.12	10.79	9.92	8.93	8.11	7.28	6.62
5½....	15.68	14.45	13.41	12.41	11.05	10.16	9.14	8.30	7.45	6.78
5⅝....	16.05	14.80	13.72	12.70	11.31	10.40	9.35	8.49	7.62	6.94
5¾....	16.43	15.14	14.04	13.00	11.57	10.64	9.57	8.69	7.80	7.10
5⅞....	16.80	15.48	14.36	13 29	11.83	10.88	9.78	8.88	7.97	7.25
6	17.17	15.83	14.67	13.58	12.09	11.12	9.99	9.07	8.14	7.41
6⅛....	17.55	16.17	14.99	13.87	12.35	11.35	10.21	9.27	8.32	7.57
6¼....	17.92	16.51	15.31	14.17	12.61	11.59	10.42	9.46	8.49	7.72
6⅜....	18.30	16.86	15.63	14.46	12.87	11.83	10.64	9.65	8.66	7.88
6½....	18.67	17.20	15.94	14.75	13.13	12.07	10.85	9.85	8.84	8.04
6⅝....	19.04	17.54	16.26	15.05	13.39	12.31	11.06	10.04	9.01	8.20
6¾....	19.42	17.89	16.58	15.34	13.65	12.54	11.28	10.23	9.18	8.35
6⅞....	19.79	18.23	16.90	15.63	13.91	12.78	11.49	10.43	9.35	8.51
7	20.16	18.57	17.21	15.92	14.17	13.02	11.70	10.62	9.53	8.67
7⅛....	20.54	18.92	17.53	16.22	14.43	13.26	11.92	10.81	9.70	8.83
7¼....	20.91	19.26	17.85	16.51	14.69	13.50	12.13	11.01	9.87	8.98
7⅜....	21.29	19.60	18.17	16.80	14.95	13.73	12.34	11.20	10.05	9.14
7½....	21.66	19.95	18.48	17.10	15.21	13.97	12.56	11.39	10.22	9.30
7⅝....	22.03	20.29	18.80	17.39	15.47	14.21	12.77	11.59	10.39	9.45
7¾....	22.41	20.64	19.12	17.68	15.73	14.45	12.98	11.78	10.57	9.61
7⅞....	22.78	20.98	19.44	17.98	15.99	14.69	13.20	11.97	10.74	9.77
8	23.15	21.32	19.75	18.27	16.25	14.93	13.41	12.17	10.91	9.93

To determine weight per foot of a tube of a given Inside

below under corre-

Gauge No.	3	4	5	6	7	8	9	10	11	12
Increase in lbs. per foot:	1.5487	1.3977	1.1174	.9514	.7480	.6286	.5067	.4145	.3334	.2743

"BRIDGEPORT" SEAMLESS BRASS TUBES

Measured in **Outside Diameters**

Gauge No.	13	14	15	16	17	18	19	20	21	22	23	24
Thickness of each No. in decimal parts of inch:	.095	.083	.072	.065	.058	.049	.042	.035	.032	.028	.025	.022
Frac. of inch, corresponding closely to Gauge Nos.:	3/32	5/64	....	1/16	....	3/64	....	.....	1/32	.....	.....	.....
Diameter Tubes, Inches.												
4	4.28	3.75	3.26	2.95	2.64	2.23	1.92	1.601	1.466	1.284	1.147	1.020
4⅛....	4.42	3.87	3.37	3.05	2.72	2.30	1.98	1.651	1.512	1.324	1.183	.....
4¼....	4.56	3.99	3.47	3.14	2.81	2.38	2.04	1.702	1.558	1.364	1.219	.....
4⅜....	4.69	4.11	3.58	3.23	2.89	2.45	2.10	1.752	1.604	1.405	1.255	.....
4½....	4.83	4.23	3.68	3.33	2.97	2.52	2.16	1.803	1.650	1.445	1.291	.....
4⅝....	4.97	4.35	3.78	3.42	3.06	2.59	2.22	1.853	1.697	1.486	.....	.....
4¾....	5.11	4.47	3.89	3.52	3.14	2.66	2.28	1.904	1.743	1.526	.....	.....
4⅞....	5.24	4.59	3.99	3.61	3.22	2.73	2.34	1.954	1.789	1.566	.....	.....
5	5.38	4.71	4.09	3.70	3.31	2.80	2.40	2.005	1.835	1.607	.....	.....
5⅛....	5.52	4.83	4.20	3.79	3.39	2.87	2.46	2.055	1.881	.....	.....	.....
5¼....	5.65	4.95	4.30	3.89	3.48	2.94	2.52	2.106	1.928	.....	.....	.....
5⅜....	5.79	5.07	4.41	3.98	3.56	3.01	2.58	2.156	1.974	.....	.....	.....
5½....	5.93	5.19	4.51	4.08	3.64	3.08	2.65	2.207	2.02	.....	.....	.....
5⅝....	6.07	5.31	4.61	4.17	3.73	3.15	2.71	2.257	.....	.....	.....	.....
5¾....	6.20	5.43	4.72	4.26	3.81	3.22	2.77	2.308	.....	.....	.....	.....
5⅞....	6.34	5.55	4.82	4.36	3.89	3.29	2.83	2.358	.....	.....	.....	.....
6	6.48	5.67	4.93	4.45	3.98	3.37	2.89	2.409	.....	.....	.....	.....
6⅛....	6.61	5.79	5.03	4.54	4.06	3.44	....	.....	.....	.....	.....	.....
6¼....	6.75	5.91	5.13	4.64	4.15	3.51	....	.....	.....	.....	.....	.....
6⅜....	6.89	6.03	5.24	4.73	4.23	3.58	....	.....	.....	.....	.....	.....
6½....	7.03	6.15	5.34	4.83	4.31	3.65	....	.....	.....	.....	.....	.....
6⅝....	7.16	6.27	5.45	4.92	4.40	3.72	....	.....	.....	.....	.....	.....
6¾....	7.30	6.39	5.55	5.01	4.48	3.79	....	.....	.....	.....	.....	.....
6⅞....	7.44	6.51	5.65	5.11	4.56	3.86	....	.....	.....	.....	.....	.....
7	7.57	6.63	5.76	5.20	4.65	3.93	....	.....	.....	.....	.....	.....
7⅛....	7.71	6.75	5.86	5.29	....	....	....	.....	.....	.....	.....	.....
7¼....	7.85	6.87	5.96	5.39	....	....	....	.....	.....	.....	.....	.....
7⅜....	7.99	6.99	6.07	5.48	....	....	....	.....	.....	.....	.....	.....
7½....	8.12	7.11	6.17	5.58	....	....	....	.....	.....	.....	.....	.....
7⅝....	8.26	7.23	6.28	5.67	....	....	....	.....	.....	.....	.....	.....
7¾....	8.40	7.35	6.38	5.76	....	....	....	.....	.....	.....	.....	.....
7⅞....	8.53	7.47	6.48	5.86	....	....	....	.....	.....	.....	.....	.....
8	8.67	7.58	6.59	5.95	....	....	....	.....	.....	.....	.....	.....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	13	14	15	16	17	18	19	20	21	22	23	24
Increase in lbs. per foot:	.2084	.1590	.1197	.0975	.0777	.0554	.0407	.0283	.0236	.0161	.0144	.0113

TABLE SHOWING WEIGHT PER FOOT OF

American or B. & S. Gauge,

Gauge No.	2	3	4	5	6	7	8	9	10	11	12	13
Thickness of each No. in decimal parts of inch:	.25763	.22942	.20431	.18194	.16202	.14428	.12849	.11443	.10189	.090742	.080808	.071961
Frac. of inch, corresponding closely to Gauge Nos.:	1/4	15/64	13/64	3/16	11/64	9/64	1/8	7/64	....	5/32	5/64	.....
Diameter Tubes, Inches.												
1/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1/4	.....	.....	.....	.....	.....	.....	.....	.....	.174	.167	.16	.15
5/16	.....	.....	.....	.....	.....	.....	.....	.....	.25	.23	.22	.20
3/8	.....	.....	.....	.....	.....	.38	.36	.34	.32	.30	.27	.25
7/16	.....	.....	.....	.....	.....	.49	.46	.43	.39	.36	.33	.31
1/2	.....	.....	.....	.67	.63	.59	.55	.51	.47	.43	.39	.36
9/16	.....	.....	.....	.80	.75	.70	.64	.59	.54	.49	.45	.41
5/8	1.09	1.05	.99	.93	.87	.80	.74	.67	.61	.56	.51	.46
11/16	1.28	1.21	1.14	1.06	.98	.90	.83	.76	.69	.63	.57	.51
3/4	1.46	1.38	1.29	1.19	1.10	1.01	.92	.84	.76	.69	.62	.56
13/16	1.65	1.55	1.43	1.32	1.22	1.11	1.01	.92	.83	.75	.68	.61
7/8	1.84	1.71	1.58	1.45	1.33	1.22	1.11	1.00	.91	.82	.74	.67
15/16	2.02	1.87	1.73	1.59	1.45	1.32	1.20	1.09	.98	.89	.80	.72
1	2.21	2.04	1.88	1.72	1.57	1.42	1.29	1.17	1.06	.95	.86	.77
1 1/8	2.58	2.37	2.17	1.98	1.80	1.63	1.48	1.33	1.20	1.08	.97	.87
1 1/4	2.95	2.70	2.47	2.24	2.03	1.84	1.66	1.50	1.35	1.21	1.09	.98
1 3/8	3.32	3.03	2.76	2.50	2.27	2.05	1.85	1.66	1.50	1.34	1.21	1.08
1 1/2	3.69	3.36	3.05	2.77	2.50	2.26	2.03	1.83	1.64	1.47	1.32	1.19
1 5/8	4.07	3.69	3.35	3.03	2.74	2.46	2.22	1.99	1.79	1.61	1.44	1.29
1 3/4	4.44	4.03	3.64	3.29	2.97	2.67	2.40	2.16	1.94	1.74	1.56	1.39
1 7/8	4.81	4.36	3.94	3.55	3.20	2.88	2.59	2.33	2.08	1.87	1.67	1.50
2	5.18	4.69	4.23	3.82	3.44	3.09	2.77	2.49	2.23	2.00	1.79	1.60
2 1/8	5.55	5.02	4.53	4.08	3.67	3.30	2.96	2.66	2.38	2.13	1.91	1.71
2 1/4	5.92	5.35	4.82	4.34	3.90	3.51	3.15	2.82	2.53	2.26	2.02	1.81
2 3/8	6.30	5.68	5.12	4.60	4.14	3.71	3.33	2.99	2.67	2.39	2.14	1.91
2 1/2	6.67	6.01	5.41	4.87	4.37	3.92	3.52	3.15	2.82	2.52	2.26	2.02
2 5/8	7.04	6.34	5.71	5.13	4.61	4.13	3.70	3.32	2.97	2.65	2.37	2.12
2 3/4	7.41	6.67	6.00	5.39	4.84	4.34	3.89	3.48	3.11	2.78	2.49	2.22
2 7/8	7.78	7.00	6.30	5.65	5.07	4.55	4.07	3.65	3.26	2.91	2.61	2.33
3	8.16	7.34	6.59	5.92	5.31	4.75	4.26	3.81	3.41	3.05	2.72	2.43
3 1/8	8.53	7.67	6.89	6.18	5.54	4.96	4.44	3.98	3.55	3.18	2.84	2.54
3 1/4	8.90	8.00	7.18	6.44	5.77	5.17	4.63	4.14	3.70	3.31	2.96	2.64
3 3/8	9.27	8.33	7.48	6.70	6.01	5.38	4.81	4.31	3.85	3.44	3.07	2.74
3 1/2	9.64	8.66	7.77	6.97	6.24	5.59	5.00	4.47	4.00	3.57	3.19	2.85
3 5/8	10.01	8.99	8.07	7.23	6.48	5.79	5.18	4.64	4.14	3.70	3.31	2.95
3 3/4	10.39	9.32	8.36	7.49	6.71	6.00	5.37	4.80	4.29	3.83	3.42	3.06
3 7/8	10.76	9.65	8.65	7.75	6.94	6.21	5.55	4.97	4.44	3.96	3.54	3.16

To determine weight per foot of a tube of a given Inside below under corre-

Gauge No.	2	3	4	5	6	7	8	9	10	11	12	13
Increase in lbs. per foot:	1.582	1.213	.9637	.7642	.6061	.4806	.3811	.3023	.2397	.1901	.1507	.1196

"BRIDGEPORT" SEAMLESS BRASS TUBES

Measured in **Outside Diameters**

Gauge No.	14	15	16	17	18	19	20	21	22	23	24	25	26
Thickness of each No. in decimal parts of inch:	.064084	.057068	.05082	.045257	.040303	.03589	.031961	.028462	.025347	.022571	.0201	.0179	.01594
Frac. of inch, corresponding closely to Gauge Nos.:	1/16	....	....	3/64	....	.....	1/32	.....	.....	....	....	....	1/64
Diameter Tubes, inches.													
1/8	....	.045	.043	.041	.039	.037	.034	.032	.028	.027	.024	.022	.020
3/16	.090	.086	.08	.07	.068	.062	.057	.053	.047	.043	.038	.035	.032
1/4	.14	.13	.12	.11	.097	.088	.080	.073	.065	.059	.053	.048	.043
5/16	.18	.17	.15	.14	.13	.114	.104	.094	.084	.076	.067	.061	.054
3/8	.23	.21	.19	.17	.15	.14	.126	.114	.102	.092	.082	.074	.066
7/16	.28	.25	.23	.20	.18	.17	.15	.135	.121	.108	.096	.087	.077
1/2	.32	.29	.26	.24	.21	.19	.17	.155	.139	.124	.111	.100	.089
9/16	.37	.33	.30	.27	.24	.22	.20	.176	.156	.141	.125	.113	.100
5/8	.42	.37	.34	.30	.27	.24	.22	.196	.174	.157	.140	.126	.112
11/16	.46	.42	.37	.33	.30	.27	.24	.22	.193	.173	.154	.139	.123
3/4	.51	.46	.41	.37	.33	.30	.26	.24	.211	.189	.169	.152	.135
13/16	.55	.50	.45	.40	.36	.32	.29	.26	.230	.206	.183	.164	.146
7/8	.60	.54	.48	.43	.39	.35	.31	.28	.248	.222	.198	.177	.158
15/16	.64	.58	.52	.47	.42	.37	.33	.30	.267	.238	.212	.190	.169
1	.69	.62	.56	.50	.45	.40	.36	.32	.285	.254	.227	.203	.181
1 1/16	.79	.70	.63	.57	.50	.45	.40	.36	.321	.297	.256	.229	....
1 1/8	.88	.79	.70	.63	.56	.50	.45	.40	.358	.320	.285	.255	....
1 3/16	.97	.87	.78	.69	.62	.55	.50	.44	.395	.352	.314	.281	....
1 1/4	1.06	.95	.85	.76	.68	.61	.54	.48	.43	.384	.343	.317	....
1 5/16	1.16	1.03	.92	.82	.74	.66	.59	.52	.47	.417	.372	....	....
1 3/4	1.25	1.12	1.00	.89	.79	.71	.63	.56	.50	.450	.401	....	....
1 7/8	1.34	1.20	1.07	.95	.85	.76	.68	.61	.54	.482	.430	....	....
2	1.43	1.28	1.14	1.02	.91	.81	.73	.65	.58	.514	.459	....	....
2 1/8	1.53	1.36	1.22	1.09	.97	.86	.77	.69	.61	.558	....	....	....
2 1/4	1.62	1.44	1.29	1.16	1.03	.92	.82	.73	.65	.580	....	....	....
2 3/8	1.71	1.53	1.36	1.22	1.08	.97	.86	.77	.69	.612	....	....	....
2 1/2	1.80	1.61	1.44	1.28	1.14	1.02	.91	.81	.73	.644	....	....	....
2 5/8	1.90	1.69	1.51	1.35	1.20	1.07	.96	.85	.76	....	....	....	....
2 3/4	1.99	1.77	1.58	1.41	1.26	1.12	1.00	.89	.80	....	....	....	....
2 7/8	2.08	1.86	1.66	1.48	1.32	1.17	1.05	.93	.83	. .	....	....	....
3	2.17	1.94	1.73	1.54	1.38	1.23	1.09	.97	.87	....	....	....	....
3 1/8	2.27	2.02	1.80	1.62	1.43	1.28	1.14	1.02	.91	....	....	....	....
3 1/4	2.36	2.10	1.88	1.68	1.49	1.33	1.19	1.06	.94	....	....	....	....
3 3/8	2.45	2.19	1.95	1.74	1.55	1.38	1.23	1.10	.98	....	....	....	....
3 1/2	2.54	2.27	2.02	1.80	1.61	1.43	1.28	1.14	1.02	....	....	....	....
3 5/8	2.64	2.35	2.10	1.87	1.67	1.49	1.33	1.18	1.05	....	....	....	....
3 3/4	2.73	2.43	2.17	1.93	1.72	1.54	1.37	1.22	1.09	....	....	....	....
3 7/8	2.82	2.52	2.24	2.00	1.78	1.59	1.42	1.26	1.13	....	....	....	....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	14	15	16	17	18	19	20	21	22	23	24	25	26
Increase in lbs. per foot:	.0948	.0752	.0596	.0473	.0375	.0297	0236	.0187	.0148	.0117	.0093	.0074	.0059

TABLE SHOWING WEIGHT PER FOOT OF

American or B & S. Gauge,

Gauge No.	2	3	4	5	6	7	8	9	10	11
Thickness of each No. in decimal parts of inch:	.25763	.22942	.20431	.18194	.16202	.14428	.12849	.11443	.10189	.090742
Frac. of inch, corresponding closely to Gauge No.:	1/4	15/64	13/64	3/16	11/64	9/64	1/8	7/64	.....	5/64
Diameter Tubes, Inches.										
4	11.13	9.98	8.95	8.02	7.18	6.42	5.74	5.13	4.58	4.09
4⅛....	11.50	10.31	9.24	8.28	7.41	6.63	5.93	5.30	4.73	4.22
4¼....	11.87	10.65	9.54	8.54	7.64	6.84	6.11	5.46	4.88	4.35
4⅜....	12.24	10.98	9.83	8.80	7.88	7.04	6.30	5.63	5.02	4.49
4½....	12.62	11.31	10.13	9.07	8.11	7.25	6.48	5.79	5.17	4.62
4⅝....	12.99	11.64	10.42	9.33	8.35	7.46	6.67	5.96	5.32	4.75
4¾....	13.36	11.97	10.72	9.59	8.58	7.67	6.85	6.12	5.47	4.88
4⅞....	13.73	12.30	11.01	9.85	8.81	7.88	7.04	6.29	5.61	5.01
5	14.10	12.63	11.31	10.12	9.05	8.08	7.22	6.45	5.76	5.14
5⅛....	14.47	12.96	11.60	10.38	9.28	8.29	7.41	6.62	5.91	5.27
5¼....	14.85	13.29	11.90	10.64	9.51	8.50	7.59	6.78	6.05	5.40
5⅜....	15.22	13.62	12.19	10.90	9.75	8.71	7.78	6.95	6.20	5.53
5½....	15.59	13.96	12.49	11.17	9.98	8.92	7.97	7.11	6.35	5.66
5⅝....	15.96	14.29	12.78	11.43	10.22	9.12	8.15	7.28	6.49	5.79
5¾....	16.33	14.62	13.08	11.69	10.45	9.33	8.34	7.44	6.64	5.92
5⅞....	16.71	14.95	13.37	11.95	10.68	9.54	8.52	7.61	6.79	6.06
6	17.08	15.28	13.67	12.22	10.92	9.75	8.71	7.77	6.94	6.19
6⅛....	17.45	15.61	13.96	12.48	11.15	9.96	8.89	7.94	7.08	6.32
6¼....	17.82	15.94	14.26	12.74	11.38	10.17	9.08	8.10	7.23	6.45
6⅜....	18.19	16.27	14.55	13.00	11.62	10.37	9.26	8.27	7.38	6.58
6½....	18.56	16.60	14.84	13.27	11.85	10.58	9.45	8.43	7.52	6.71
6⅝....	18.94	16.93	15.14	13.53	12.09	10.79	9.63	8.60	7.67	6.84
6¾....	19.31	17.27	15.43	13.79	12.32	11.00	9.82	8.77	7.82	6.97
6⅞....	19.68	17.60	15.73	14.05	12.55	11.21	10.00	8.93	7.96	7.10
7	20.05	17.93	16.02	14.32	12.79	11.41	10.19	9.10	8.11	7.23
7⅛....	20.42	18.26	16.32	14.58	13.02	11.62	10.38	9.26	8.26	7.36
7¼....	20.79	18.59	16.61	14.84	13.25	11.83	10.56	9.43	8.41	7.50
7⅜....	21.17	18.92	16.91	15.10	13.49	12.04	10.75	9.59	8.55	7.63
7½....	21.54	19.25	17.20	15.37	13.72	12.25	10.93	9.76	8.70	7.76
7⅝....	21.91	19.58	17.50	15.63	13.96	12.45	11.12	9.92	8.85	7.89
7¼....	22.28	19.91	17.79	15.89	14.19	12.66	11.30	10.09	8.99	8.02
7⅞....	22.65	20.24	18.09	16.15	14.42	12.87	11.49	10.25	9.14	8.15
8	23.03	20.58	18.38	16.42	14.66	13.08	11.67	10.42	9.29	8.28

To determine weight per foot of a tube of a given Inside

below under corre-

Gauge No.	2	3	4	5	6	7	8	9	10	11
Increase in lbs. per foot:	1.532	1.213	.9637	.7642	.6061	.4806	.3811	.3023	.2397	.1901

"BRIDGEPORT" SEAMLESS BRASS TUBES

Measured in Outside Diameters

Gauge No.	12	13	14	15	16	17	18	19	20	21	22	23
Thickness of each No. in decimal parts of inch:	.080808	.071961	.064084	.057068	.05082	.045257	.040303	.03589	.031961	.028462	.025347	.022571
Frac. of inch, corresponding closely to Gauge Nos.:	5/64	....	1/16	....	....	3/64	....	.....	1/32	.....	.....	.....
Diameter Tubes, Inches.												
4	3.66	3.26	2.91	2.60	2.32	2.06	1.84	1.64	1.46	1.30	1.16	....
4⅛....	3.77	3.37	3.01	2.68	2.39	2.14	1.90	1.69	1.51	1.34	.....	.....
4¼....	3.89	3.47	3.10	2.76	2.46	2.20	1.96	1.74	1.55	1.39	.....	.....
4⅜....	4.01	3.58	3.19	2.84	2.54	2.26	2.01	1.80	1.60	1.43	.....	.....
4½....	4.12	3.68	3.28	2.93	2.61	2.32	2.07	1.85	1.64	1.47	.....	.....
4⅝....	4.24	3.78	3.38	3.01	2.68	2.39	2.13	1.90	1.69	.....	.....	.....
4¾....	4.36	3.89	3.47	3.09	2.76	2.46	2.19	1.95	1.74	.....	.....	.....
4⅞....	4.47	3.99	3.56	3.17	2.83	2.52	2.25	2.00	1.79	.....	.....	.....
5	4.59	4.09	3.65	3.26	2.90	2.59	2.31	2.05	1.83	.....	.....	.....
5⅛....	4.71	4.20	3.75	3.34	2.98	2.66	2.36	2.11	.....	.....	.....	.....
5¼....	4.82	4.30	3.84	3.42	3.05	2.72	2.42	2.16	.....	.....	.....	.....
5⅜....	4.94	4.41	3.93	3.50	3.12	2.78	2.48	2.21	.....	.....	.....	.....
5½....	5.06	4.51	4.02	3.59	3.20	2.85	2.54	2.26	.....	.....	.....	.....
5⅝....	5.17	4.61	4.12	3.67	3.27	2.91	2.60	.....	.....	.....	.....	.....
5¾....	5.29	4.72	4.21	3.75	3.34	2.98	2.65	.....	.....	.....	.....	.....
5⅞....	5.41	4.82	4.30	3.83	3.42	3.04	2.71	.....	.....	.....	.....	.....
6	5.52	4.93	4.39	3.92	3.49	3.11	2.77	.....	.....	.....	.....	.....
6⅛....	5.64	5.03	4.49	4.00	3.57	....	....	.....	.....	.....	.....	.....
6¼....	5.76	5.13	4.58	4.08	3.64	....	....	.....	.....	.....	.....	.....
6⅜....	5.87	5.24	4.67	4.16	3.71	....	....	.....	.....	.....	.....	.....
6½....	5.99	5.34	4.76	4.25	3.78	....	....	.....	.....	.....	.....	.....
6⅝....	6.11	5.45	4.86	4.33	3.85	....	....	.....	.....	.....	.....	.....
6¾....	6.22	5.55	4.95	4.41	3.93	....	....	.....	.....	.....	.....	.....
6⅞....	6.34	5.65	5.04	4.49	4.01	....	....	.....	.....	.....	.....	.....
7	6.46	5.76	5.13	4.57	4.08	...	....	... ..	.....	.....	.....	.....
7⅛....	6.57	5.86	5.23	....	....	....	....	... ..	.....	.....	.....	.....
7¼....	6.69	5.96	5.32	....	....	....	....	.....	.....	.....	.....	.....
7⅜....	6.80	6.07	5.41	....	....	....	....	.....	.....	.....	.....	.....
7½....	6.92	6.17	5.50	....	....	....	....	.....	.....	.....	.....	.....
7⅝....	7.04	6.28	5.60	....	....	....	....	.....	.....	.....	.....	.....
7¾....	7.15	6.38	5.69	....	....	....	....	.....	.....	.....	.....	.....
7⅞....	7.27	6.48	5.78	....	....	....	....	.....	.....	.....	.....	.....
8	7.39	6.59	5.87	....	....	....	....	.....	.....	.....	.....	.....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	12	13	14	15	16	17	18	19	20	21	22	23
Increase in lbs. per foot:	.1507	.1195	.0948	.0752	.0596	.0473	.0375	.0297	.0236	.0187	.0148	.0117

PRICES FOR "BRIDGEPORT" SEAMLESS BRASS TUBES—STUB'S WIRE GAUGE STANDARD

Prices are per Pound and are to be added to the Ruling Base Price

Stub's or Birmingham Gauge.	Decimal Inch.	Outside Diameters in Inches. The Base Price only is charged where the Shaded Blanks are printed.																						
		3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2
4 to 11	.238 to .120	....	...	....	....	....	....	....	....											.01	.01	.01	.03
12	.109	....	....	....	....	.06	.05	.05	.05											.02	.02	.02	.04
13	.095	....	....	....	....	.07	.05	.05	.05											.03	.03	.03	.05
14	.083	. ..	....	.07	.07	.07	.05	.05	.05	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.04	.04	.04	.06
15	.072	....	.08	.07	.07	.07	.05	.05	.05	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.06	.06	.06	.07
16	.065	.08	.08	.07	.07	.07	.05	.05	.05	.02	.02	.02	.02	.02	.02	.02	.02	.02	.05	.06	.07	.08	.11
17	.058	.08	.08	.07	.07	.07	.05	.05	.05	.03	.03	.03	.03	.03	.03	.03	.03	.05	.06	.07	.08	.09	.12
18	.049	.09	.09	.08	.08	.08	.06	.06	.06	.04	.04	.04	.04	.04	.04	.04	.06	.07	.08	.09	.10	.11	.14
19	.042	.09	.09	.08	.08	.08	.06	.06	.06	.05	.05	.05	.05	.05	.05	.07	.08	.09	.10	.11	.13	.15	.17
20	.035	.09	.09	.08	.08	.08	.06	.06	.06	.06	.06	.06	.06	.06	.07	.07	.08	.09	.11	.11	.13	.19	.19
21	.032	.11	.10	.10	.08	.08	.07	.07	.07	.07	.07	.07	.07	.07	....	....	....	....	....	....	....	....	....
22	.028	.13	.13	.11	.11	.09	.08	.08	.08	.08	.08	.08	.08	.08	....	....	....	....	....	....	....	....	....
23	.025	.15	.15	.13	.13	.11	.11	.11	.11	.11	.11	.11	.13	.15	....	....	....	....	....	....	....	....	....
24	.022	.31	.26	.24	.23	.22	.21	.19	.18	.18	.19	.19	.20	.21	....	....	....	....	....	....	....	....	....
25	.020	.34	.29	.27	.25	.24	.23	.22	.22	.23	.24	....	....	....	....	....	....	....	....	....	....	....	....

BASE PRICE

Additional Prices for Admiralty, Low Brass, Copper, Bronze and Gilding quoted upon request.

For all Seamless Tubes of any shape other than round, add to the above price of Regular Round Tubes, of corresponding size, per pound additional, $0.05.

Sizes between Gauges and Diameters, take Price of nearest Gauge or Diameter. Thus: Tube with wall .069 thick would take Price of Tube .072 thick, or No. 15 Gauge.

PRICES FOR "BRIDGEPORT" SEAMLESS BRASS TUBES—STUB'S WIRE GAUGE STANDARD

Prices given are per Pound and are to be added to the Ruling Base Price

Stub's or Birmingham Gauge.	Decimal Inch.	Outside Diameters in Inches.																					
		4¾	5	5¼	5½	5¾	6	6¼	6½	6¾	7	7¼	7½	7¾	8	8½	9	9½	10	—	—	—	—
4 to 11	.238 to .120	.03	.05	.05	.06	.06	.07	.07	.07	.07	.07	.09	.09	.09	.11	.11	.11	.14	.17	....	....	....	....
12	.109	.04	.06	.06	.07	.07	.08	.08	.08	.08	.08	.10	.10	.10	.12	.12	.12	.15	.18	....	....	....	....
13	.095	.05	.07	.07	.08	.08	.09	.09	.09	.09	.09	.11	.11	.11	.13	.13	.13	.16	.19	...	....	....	....
14	.083	.05	.08	.08	.09	.09	.10	.10	.10	.10	.10	.12	.12	.12	.14	.14	.14	....	....	....	....	....	....
15	.072	.07	.09	.09	.11	.11	.14	.14	.14	.16	.16	.19	.19	.19	....	....	....	....	....	....	....	....	....
16	.065	.11	.11	.16	.16	.16	.19	.19	.23	.23	.23	.26	.26	.26	....	....	....	....	....	....	....	....	....
17	.058	.12	.12	.17	.17	.17	.20	.20	.24	.24	.24	.27	.27	.27	....	....	....	....	....	....	....	....	....
18	.049	.14	.14	.20	.20	.20	.23	.23	.30	.30	.30	....	....	....	....	....	....	....	....	....	....	....	....
19	.042	.21	.21	.25	.29	.31	.31	...	....	...	....	....	....	....	....	..	....	....	....	....	....	....	...
20	.035	.23	.23	.31	.31	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
21	.032	....	....	...	....	....	....	....	....	....	....	....	....	...	....	....	....	....	....	....	....	....	....
22	.028	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
23	.025	....	....	....	....	....	....	....	....	....	....	....	....	...	....	....	....	....	....	....	....	....	....
24	.022	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25	.020	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

Additional Prices for Admiralty, Low Brass, Copper, Bronze and Gilding quoted upon request.

For all Seamless Tubes of any shape other than round, add to the above price of regular Round Tubes, of corresponding size, per pound additional, $0.05.

Sizes between Gauges or Diameters, take Price of nearest Gauge or Diameter. Thus: Tube with wall .069 thick would take Price of Tube .072 thick or No. 15 Gauge.

Extras for tinning see Page 36.

ADDITIONAL PRICES FOR "BRIDGEPORT" SEAMLESS HIGH GRADE CONDENSER TUBES

Brass and Admiralty Mixture

The Prices given are per Pound and are to be added to the Ruling Base Price of Seamless Brass Tubes, see page 34

Stub's Gauge	Additional Price for Seamless Brass Condenser Tubes					Additional Price for Admiralty Tubes			
	Dec. of Inches	5/8 in.	3/4 in.	7/8 in.	1 in.	5/8 in.	3/4 in.	7/8 in.	1 in.
16	.065	.04	.04	.04	.04	.08	.08	.08	.08
17	.058	.04	.04	.04	.04	.08	.08	.08	.08
18	.049	.04	.04	.04	.04	.08	.08	.08	.08
19	.042	.06	.06	.06	.06	.10	.10	.10	.10
20	.035	.08	.06	.06	.06	.12	.10	.10	.10

For all Seamless Tubes of any shape other than Round add to the above price of regular round tubes of corresponding size Per lb. additional .05

For Tinning inside and outside ..... " " .02

For Tinning Tubes inside and outside other than Brass Condenser Tubes of sizes above specified ..... " " .04

For Tinning any size or kind of Tube on one side only ..... " " .05

For Tinning Tubes in lengths not over three inches on ends only, an extra charge of not less than ..... Per end additional .01

PRICES FOR "BRIDGEPORT" SEAMLESS BRASS TUBES — IRON PIPE SIZES

Prices given are per Pound and are to be added to the Ruling Base Price

The base price is charged only where the shaded blocks are printed.

Iron Pipe Size...	⅛ in.	¼ in.	⅜ in.	½ in.	¾ in.	1 in.	1¼ in.	1½ in.	2 in.	2½ in.	3 in.	3½ in.	4 in.	4½ in.	5 in.	6 in.	7 in.	8 in.
Per lb. advance.....	.08	.07	.02	.01	BASE PRICE							.01	.02	.04	.06	.07	.09	.11

Base Price is..... Subject to change without notice.

ADDITIONAL PRICES FOR CUTTING TO EXACT LENGTHS, IF REQUIRED, 24 INCHES OR LESS

Lengths.....	Over 12 to 24 in. Inclusive.	Over 9 to 12 in. Inclusive.	Over 6 to 9 in. Inclusive.	Over 4 to 6 in. Inclusive.	Over 2 to 4 in. Inclusive.	Over 1 to 2 in. Inclusive.	Over ¾ to 1 in. Inclusive.
Add per pound.....	.01	.01⅛	.02	.02⅛	.03	.03⅛	.04

Additional Prices for Copper, Bronze or Gilding, quoted on request.

No Additional Charge for cutting Tube to exact lengths if required, over 24 inches.

TABLE SHOWING SIZES (in dec. of inch), WEIGHTS, CIRCUMFERENCE AND TRANSVERSE AREAS OF SEAMLESS BRASS AND COPPER TUBING, IRON PIPE SIZES

Size Same as Iron Pipe Inches	WEIGHT OF REGULAR IRON PIPE SIZES Brass = .307 cu. in. Copper = .321 cu. in.												WEIGHT OF EXTRA HEAVY IRON PIPE SIZES Brass = .306 cu. in. Copper = .321 cu .in.				
	O.D.	I.D.	Thickness	Circumference		Transverse Areas			Weight per Foot		Weight 12 Feet		Thickness	Weight per Foot		Weight 12 Feet	
				Outside	Inside	Outside	Inside	Metal	Brass	Copper	Brass	Copper		Brass	Copper	Brass	Copper
⅛	.405	.281	.0620	1.272	0.883	0.129	0.062	0.0668	.246	.2573	2.952	3.0876	.100	.35178	.36902	4.2214	4.4282
¼	.540	.375	.0825	1.696	1.178	.229	.110	.119	.437	.4584	5.244	5.5008	.123	.59168	.62068	7.1002	7.4482
⅜	.675	.494	.0905	2.121	1.552	.358	.192	.166	.612	.6394	7.344	7.6728	.127	.80288	.84224	9.6346	10.1069
½	.840	.625	.1075	2.639	1.964	.554	.307	.247	.911	.9514	10.932	11.4168	.149	1.1867	1.2449	14.240	14.939
¾	1.050	.822	.1140	3.299	2.582	.866	.531	.335	1.24	1.291	14.88	15.492	.157	1.6173	1.6966	19.408	20.359
1	1.315	1.062	.1265	4.131	3.336	1.358	.886	.472	1.74	1.818	20.88	21.816	.182	2.3783	2.4949	20.540	29.939
1¼	1.660	1.368	.1460	5.215	4.298	2.164	1.470	.694	2.56	2.673	30.72	32.076	.194	3.2798	3.4406	39.358	41.287
1½	1.900	1.600	.1500	5.969	5.027	2.835	2.011	.825	3.04	3.178	36.48	38.136	.203	3.9694	4.1640	47.633	49.9680
2	2.375	2.062	.1565	7.461	6.478	4.430	3.339	1.091	4.02	4.203	48.24	50.436	.221	5.4874	5.7564	65.849	69.077
2½	2.875	2.500	.1875	9.032	7.854	6.492	4.909	1.583	5.83	6.098	69.96	73.176	.280	8.7937	8.7937	100.595	105.524
3	3.500	3.062	.2190	10.996	9.620	9.621	7.364	2.257	8.32	8.694	99.84	104.328	.304	11.167	11.715	134.004	140.580
3½	4.000	3.500	.2500	12.566	10.996	12.566	9.621	2.945	10.85	11.35	130.20	136.20	.321	13.624	14.292	163.488	171.504
4	4.500	4.000	.2500	14.137	12.566	15.904	12.566	3.338	12.30	12.68	147.60	154.32	.421	16.359	17.161	196.308	205.932
4½	5.000	4.500	.2500	15.708	14.137	19.635	15.904	3.731	13.74	14.37	164.88	172.44	.....	.....	.....	.....	.....
5	5.563	5.062	.2505	17.477	15.903	24.306	20.125	4.181	15.40	16.11	184.80	193.32	.....	.....	.....	.....	.....
6	6.625	6.125	.2500	20.813	19.242	34.472	29.465	5.007	18.45	19.29	221.40	231.48	.....	.....	.....	.....	.....
7	7.625	7.062	.2815	23.955	22.186	45.664	39.169	6.494	23.92	25.02	287.04	300.24	.....	.....	.....	.....	.....

NET PRICES FOR POLISHING, POLISHING AND LACQUERING, POLISHING AND NICKEL PLATING AND THREADING SEAMLESS BRASS AND COPPER TUBES AND PIPES

Iron Pipe Sizes	Plumbers' Sizes and all other Tubes by Outside Diameters	Polishing	Polishing and Lacquering	Polishing and Nickel Plating	Threading
Inches	Inches	Cts. per ft.	Cts. per ft.	Cts. per ft.	Cts. per end
....	¼	1½	2	2	3
⅛	⅜	1½	2	2	3
¼	½	1¾	2⅕	2⅕	3
⅜	⅝	1⅞	2⅖	2⅖	3
½	¾	2⅕	2½	2½	3
....	⅞	2¼	2⅝	2⅝	3
¾	1	2½	2¾	2¾	3
....	1⅛	2¾	2⅞	2⅞	3
1	1¼	3	3⅛	3⅛	3
....	1⅜	3¼	3⅜	3⅜	3
....	1½	3⅜	3½	3½	3½
1¼	1⅝	3½	3¾	3¾	4
....	1¾	3¾	4	4	4½
1½	1⅞	4	4¼	4¼	5
....	2	4¼	4½	4½	6
2	2¼	4½	4¾	4¾	7
....	2½	5	5¼	5¼	8½
2½	2¾	5½	5¾	5¾	10
....	3	6	6¼	6¼	12
....	3¼	6½	6¾	6¾	13½
3	3½	7	7½	7½	15
....	3¾	7¾	9	9	17½
3½	4	8½	11	11	20
4	4½	10	14	14	20
4½	5	12	18	18	25
5	5½	15	21	21	30
....	6	18	24	24	38
6	6½	22	27	27	45

A special discount of 10 per cent. on above prices may be given on an order of 500 feet or over of a size ordered at one time.

For 2¼ inch and 3 inch Tubing, either outside diameter or inside diameter, when ordered in thousand feet or more at a time price of on application.

2¾ cents per running foot for 2¼ inch Tube, and 3½ cents per running foot for 3 inch Tube.

TABLE SHOWING WEIGHT PER FOOT OF

Stub's or Birmingham Gauge,

Gauge No.	3	4	5	6	7	8	9	10	11	12	13	14
Thickness of each No. in decimal parts of inch :	.259	.238	.220	.203	.180	.165	.148	.134	.120	.109	.095	.083
Frac. of inch, orresponding closely to Gauge Nos.:	1/4	15/64	.....	13/64	3/16	11/64	9/64	....	1/8	.....	3/32	5/64
Diameter Tubes, Inches.												
1/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1/4	.....	.....	.....	.....	.....	.....	.....	.....	.19	.186	.178	.168
5/16	.....	.....	.....	.....	.....	.....	.....	.....	.28	.269	.250	.231
3/8	.....	.....	.....	.....	.....	.42	.41	.39	.37	.352	.322	.294
7/16	.....	.....	.....	.....	.....	.55	.51	.49	.46	.434	.395	.357
1/2	.....	.....	.....	.73	.69	.67	.63	.60	.56	.517	.466	.420
9/16	.....	.....	.....	.88	.83	.80	.75	.69	.64	.600	.539	.483
5/8	1.14	1.11	1.08	1.04	.97	.92	.85	.80	.73	.681	.610	.546
11/16	1.34	1.29	1.25	1.19	1.10	1.04	.97	.90	.83	.764	.682	.609
3/4	1.54	1.48	1.42	1.34	1.24	1.17	1.08	1.00	.91	.847	.754	.672
13/16	1.73	1.66	1.57	1.50	1.38	1.29	1.19	1.10	1.01	.929	.826	.735
7/8	1.93	1.84	1.74	1.65	1.51	1.42	1.30	1.21	1.09	1.012	.898	.797
15/16	2.13	2.02	1.91	1.81	1.65	1.54	1.42	1.30	1.19	1.094	.970	.860
1	2.33	2.19	2.08	1.96	1.78	1.67	1.52	1.41	1.28	1.18	1.04	.92
1 1/16	2.73	2.56	2.41	2.27	2.06	1.92	1.75	1.61	1.46	1.34	1.19	1.05
1 1/4	3.12	2.92	2.74	2.57	2.33	2.17	1.97	1.82	1.64	1.51	1.33	1.18
1 3/16	3.52	3.28	3.08	2.89	2.60	2.41	2.20	2.02	1.83	1.67	1.47	1.30
1 1/2	3.91	3.64	3.41	3.19	2.88	2.67	2.43	2.22	2.01	1.84	1.62	1.43
1 5/16	4.29	4.00	3.75	3.50	3.15	2.92	2.65	2.43	2.18	2.01	1.76	1.55
1 3/4	4.69	4.36	4.07	3.80	3.42	3.17	2.88	2.62	2.37	2.16	1.91	1.68
1 7/8	5.08	4.72	4.41	4.12	3.70	3.42	3.10	2.82	2.55	2.33	2.05	1.81
2	5.47	5.08	4.75	4.42	3.97	3.67	3.32	3.03	2.73	2.50	2.19	1.93
2 1/16	5.87	5.44	5.08	4.72	4.24	3.92	3.55	3.23	2.92	2.67	2.34	2.06
2 1/4	6.26	5.81	5.41	5.04	4.51	4.17	3.77	3.43	3.10	2.82	2.48	2.18
2 3/16	6.66	6.16	5.74	5.34	4.79	4.42	3.99	3.64	3.28	2.99	2.62	2.31
2 1/2	7.05	6.52	6.08	5.65	5.06	4.67	4.22	3.84	3.46	3.16	2.77	2.44
2 5/16	7.43	6.89	6.42	5.95	5.33	4.92	4.44	4.04	3.64	3.33	2.91	2.56
2 3/4	7.83	7.24	6.74	6.27	5.61	5.17	4.66	4.25	3.82	3.49	3.06	2.69
2 7/8	8.22	7.60	7.08	6.57	5.88	5.42	4.89	4.45	4.00	3.65	3.20	2.81
3	8.61	7.97	7.41	6.88	6.15	5.67	5.11	4.65	4.19	3.82	3.35	2.93
3 1/16	9.01	8.33	7.75	7.19	6.43	5.92	5.33	4.86	4.37	3.98	3.49	3.06
3 1/4	9.40	8.68	8.07	7.50	6.70	6.17	5.56	5.06	4.55	4.15	3.63	3.18
3 3/16	9.80	9.05	8.41	7.80	6.97	6.42	5.79	5.26	4.74	4.32	3.78	3.31
3 1/2	10.18	9.41	8.75	8.11	7.24	6.67	6.01	5.47	4.91	4.48	3.92	3.43
3 5/16	10.57	9.76	9.08	8.42	7.52	6.92	6.24	5.67	5.09	4.64	4.06	3.56
3 3/4	10.97	10.13	9.41	8.73	7.79	7.17	6.46	5.87	5.28	4.81	4.21	3.69
3 7/8	11.36	10.49	9.74	9.03	8.06	7.42	6.69	6.08	5.46	4.98	4.36	3.81

To determine weight per foot of a tube of a given Inside below under corre-

Gauge No.	3	4	5	6	7	8	9	10	11	12	13	14
Increase in lbs. per foot :	1.6361	1.3781	1.1733	.9990	.7884	.6599	.5310	.4852	.3490	.2880	.2188	.1669

"BRIDGEPORT" SEAMLESS *COPPER* TUBES

Measured in **Outside Diameters**

Gauge No.	15	16	17	18	19	20	21	22	23	24	25	26	27
Thickness of each No. in decimal parts of inch:	.072	.065	.058	.049	.042	.035	.032	.028	.025	.022	.020	.018	.016
Frac. of inch, corresponding closely to Gauge Nos.:	....	1/16	....	3/64	....	.....	1/32	.....	.....	....	....	....	1/64
Diameter Tubes, Inches.													
1/8	....	.048	.047	.045	.042	.038	.036	.033	.030	.027	.025	.023	.021
1/16	.101	.097	.091	.082	.073	.065	.060	.054	.049	.044	.041	.037	.034
1/4	.155	.146	.135	.120	.106	.091	.084	.076	.068	.061	.056	.050	.045
5/16	.210	.195	.178	.156	.138	.118	.109	.097	.087	.078	.070	.064	.058
3/8	.265	.245	.223	.193	.169	.144	.133	.118	.106	.094	.086	.078	.069
7/16	.319	.293	.267	.231	.202	.171	.157	.139	.125	.111	.101	.091	.082
1/2	.374	.342	.311	.268	.233	.197	.182	.160	.144	.127	.117	.105	.093
9/16	.428	.392	.355	.304	.265	.224	.206	.182	.163	.144	.131	.119	.106
5/8	.483	.441	.399	.342	.297	.250	.230	.203	.182	.161	.147	.132	.118
11/16	.537	.490	.442	.379	.329	.277	.254	.224	.201	.177	.162	.146	.130
3/4	.591	.540	.486	.416	.360	.303	.278	.245	.219	.194	.177	.160	.143
13/16	.646	.589	.530	.454	.392	.330	.302	.266	.238	.211	.192	.173	.155
7/8	.700	.638	.574	.490	.424	.356	.327	.288	.257	.228	.207	.187	.167
15/16	.755	.688	.618	.527	.456	.383	.351	.309	.276	.244	.222	.201	.180
1	.81	.73	.66	.57	.48	.408	.376	.330	.295	.260	.237	.214	.191
1 1/16	.91	.83	.75	.64	.55	.461	.424	.372	.333	.294	.268	.241	.215
1 1/8	1.03	.93	.84	.71	.62	.514	.472	.415	.372	.328	.298	.269	.239
1 3/16	1.13	1.03	.92	.79	.68	.567	.521	.457	.409	.360	.329	.296	.264
1 1/4	1.25	1.13	1.01	.86	.75	.621	.569	.500	.447	.394	.359	.323	.288
1 5/16	1.35	1.23	1.10	.93	.81	.673	.617	.542	.485	.427	.390	.351	....
1 3/8	1.46	1.32	1.19	1.01	.87	.727	.667	.584	.523	.461	.419	.378	....
1 7/16	1.57	1.43	1.28	1.08	.93	.779	.715	.627	.561	.493	.449	.405	....
2	1.68	1.52	1.36	1.15	1.00	.833	.763	.669	.598	.527	.480	.433	....
2 1/16	1.80	1.63	1.45	1.23	1.06	.885	.812	.712	.636	.561	.510	....	....
2 1/8	1.90	1.72	1.54	1.30	1.12	.939	.860	.754	.674	.594	.541	....	....
2 3/16	2.01	1.82	1.63	1.39	1.19	.991	.909	.796	.712	.627	.571	....	....
2 1/4	2.12	1.92	1.71	1.46	1.25	1.045	.958	.839	.750	.660	.602	....	....
2 5/16	2.23	2.02	1.81	1.53	1.31	1.097	1.006	.881	.787	.694	....	....	....
2 3/8	2.34	2.11	1.89	1.61	1.38	1.151	1.054	.924	.825	.728	....	....	....
2 7/16	2.45	2.22	1.98	1.68	1.44	1.203	1.100	.966	.863	.760	....	....	....
3	2.55	2.31	2.07	1.75	1.50	1.257	1.151	1.008	.902	.794	....	....	....
3 1/16	2.67	2.42	2.15	1.83	1.56	1.309	1.200	1.051	.940	.827	....	....	....
3 1/8	2.77	2.51	2.25	1.90	1.63	1.363	1.248	1.093	.978	.861	....	....	....
3 3/16	2.88	2.60	2.33	1.97	1.70	1.415	1.297	1.136	1.015	.894	....	....	....
3 1/4	2.99	2.71	2.41	2.05	1.76	1.469	1.345	1.178	1.053	.927	....	....	....
3 5/16	3.10	2.80	2.51	2.12	1.83	1.521	1.393	1.220	1.091	.961	....	....	....
3 3/4	3.21	2.90	2.59	2.19	1.89	1.575	1.442	1.263	1.129	.993	....	....	....
3 7/16	3.32	3.00	2.69	2.27	1.95	1.627	1.491	1.305	1.167	1.027	....	....	....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	15	16	17	18	19	20	21	22	23	24	25	26	27
Increase in lbs. per foot:	.1257	.1024	.0816	.0682	.0427	.0297	.0248	.0190	.0151	.0118	.0097	.0079	.0062

TABLE SHOWING WEIGHT PER FOOT OF

Stub's or Birmingham Gauge,

Gauge No.	3	4	5	6	7	8	9	10	11	12
Thickness of each No. in decimal parts of inch:	.259	.238	.220	.203	.180	.165	.148	.134	.120	.109
Frac. of inch, corresponding closely to Gauge No.:	1/4	15/64	.....	13/64	3/16	11/64	9/64	.....	1/8	.....
Diameter Tubes, Inches.										
4	11.75	10.85	10.08	9.34	8.34	7.68	6.91	6.28	5.64	5.13
4⅛....	12.15	11.21	10.41	9.65	8.61	7.92	7.13	6.48	5.83	5.30
4¼....	12.54	11.57	10.74	9.95	8.88	8.17	7.36	6.69	6.01	5.47
4⅜....	12.94	11.93	11.08	10.26	9.16	8.42	7.58	6.89	6.18	5.64
4½....	13.32	12.30	11.41	10.57	9.43	8.67	7.80	7.09	6.36	5.80
4⅝....	13.71	12.65	11.74	10.88	9.70	8.92	8.03	7.29	6.55	5.96
4¾....	14.11	13.01	12.07	11.18	9.97	9.17	8.25	7.50	6.73	6.13
4⅞....	14.50	13.38	12.41	11.50	10.25	9.42	8.47	7.70	6.91	6.30
5	14.89	13.73	12.75	11.80	10.52	9.67	8.70	7.91	7.10	6.46
5⅛....	15.29	14.09	13.07	12.11	10.79	9.92	8.92	8.11	7.28	6.63
5¼....	15.68	14.46	13.41	12.41	11.06	10.17	9.15	8.31	7.46	6.79
5⅜....	16.08	14.82	13.74	12.73	11.33	10.42	9.38	8.52	7.64	6.95
5½....	16.46	15.17	14.08	13.03	11.60	10.67	9.60	8.71	7.82	7.12
5⅝....	16.85	15.54	14.41	13.33	11.88	10.92	9.82	8.91	8.00	7.29
5¾....	17.25	15.90	14.74	13.65	12.15	11.17	10.05	9.12	8.19	7.45
5⅞....	17.64	16.25	15.08	13.95	12.42	11.42	10.27	9.32	8.37	7.62
6	18.03	16.62	15.40	14.26	12.69	11.68	10.49	9.52	8.55	7.78
6⅛....	18.43	16.98	15.74	14.56	12.97	11.92	10.72	9.73	8.74	7.95
6¼....	18.82	17.33	16.07	14.88	13.24	12.17	10.94	9.93	8.91	8.11
6⅜....	19.21	17.70	16.41	15.18	13.51	12.42	11.17	10.13	9.09	8.27
6½....	19.60	18.06	16.74	15.49	13.79	12.67	11.39	10.34	9.28	8.44
6⅝....	19.99	18.42	17.07	15.80	14.06	12.92	11.61	10.54	9.46	8.61
6¾....	20.39	18.78	17.41	16.11	14.33	13.17	11.84	10.74	9.64	8.77
6⅞....	20.78	19.14	17.74	16.41	14.60	13.42	12.06	10.95	9.82	8.93
7	21.17	19.50	18.07	16.72	14.88	13.67	12.28	11.15	10.01	9.10
7⅛....	21.57	19.87	18.41	17.03	15.15	13.92	12.52	11.35	10.18	9.27
7¼....	21.96	20.22	18.74	17.33	15.42	14.17	12.74	11.56	10.36	9.43
7⅜....	22.35	20.58	19.08	17.64	15.70	14.42	12.96	11.76	10.55	9.60
7½....	22.74	20.95	19.40	17.95	15.97	14.67	13.19	11.96	10.73	9.76
7⅝....	23.13	21.30	19.74	18.26	16.24	14.92	13.41	12.17	10.91	9.92
7¾....	23.53	21.67	20.08	18 56	16.52	15.17	13.63	12.37	11.10	10.09
7⅞....	23.92	22.03	20.41	18.88	16.79	15.42	13.86	12.57	11.28	10.26
8	24.32	22.39	20.74	19.18	17.06	15.68	14.08	12.78	11.46	10.43

To determine weight per foot of a tube of a given Inside below under corre-

Gauge No.	3	4	5	6	7	8	9	10	11	12
Increase in lbs. per foot:	1.6261	1.3731	1.1733	.9990	.7854	.6599	.5310	.4352	.3[illegible]	.2880

"BRIDGEPORT" SEAMLESS *COPPER* TUBES

Measured in Outside Diameters

Gauge No.	13	14	15	16	17	18	19	20	21	22	23	24
Thickness of each No. in decimal parts of inch:	.095	.083	.072	.065	.058	.049	.042	.035	.032	.028	.025	.022
Frac. of inch, corresponding closely to Gauge Nos.:	3/32	5/64	....	1/16	....	3/64	....	.....	1/32	.....	.....	.....
Diameter Tubes, Inches.												
4	4.49	3.94	3.42	3.10	2.77	2.34	2.02	1.681	1.539	1.348	1.204	1.060
4⅛....	4.64	4.06	3.54	3.20	2.86	2.41	2.08	1.733	1.588	1.390	1.242	.....
4¼....	4.79	4.19	3.64	3.30	2.95	2.50	2.14	1.787	1.636	1.432	1.280	.....
4⅜....	4.92	4.32	3.76	3.39	3.03	2.57	2.20	1.840	1.684	1.475	1.318	.....
4½....	5.07	4.44	3.86	3.50	3.12	2.65	2.27	1.893	1.732	1.517	1.356	.....
4⅝....	5.22	4.57	3.97	3.59	3.21	2.72	2.33	1.946	1.782	1.560	.....	.....
4¾....	5.37	4.69	4.08	3.70	3.30	2.79	2.39	1.999	1.830	1.602	.....	.....
4⅞....	5.50	4.82	4.19	3.79	3.38	2.87	2.46	2.052	1.878	1.644	.....	.....
5	5.65	4.95	4.29	3.88	3.48	2.94	2.52	2.105	1.927	1.687	.....	.....
5⅛...	5.80	5.07	4.41	3.98	3.56	3.01	2.58	2.158	1.975	.....	.....	.....
5¼....	5.93	5.20	4.52	4.08	3.65	3.09	2.65	2.211	2.024	.....	.....	.....
5⅜....	6.08	5.32	4.63	4.18	3.74	3.16	2.71	2.264	2.073	.....	.....	.....
5½....	6.23	5.45	4.74	4.28	3.82	3.23	2.78	2.317	2.12	... ..	.....	.....
5⅝....	6.37	5.58	4.84	4.38	3.92	3.31	2.85	2.370	.....	.....	.....	.....
5¾....	6.51	5.70	4.96	4.47	4.00	3.38	2.91	2.423	.....	.....	.....	.....
5⅞....	6.66	5.83	5.07	4.58	4.08	3.46	2.97	2.476	.....	.....	.....	.....
6	6.80	5.95	5.18	4.67	4.18	3.54	3.03	2.529	.....	.....	.....	.....
6⅛....	6.94	6.08	5.28	4.77	4.26	3.61	....	.....	.....	.....	.....	.....
6¼....	7.09	6.20	5.39	4.87	4.36	3.68	....	.....	.....	.....	.....	.....
6⅜....	7.23	6.33	5.50	4.97	4.44	3.76	....	.....	.....	.....	.....	.....
6½....	7.38	6.46	5.61	5.07	4.53	3.83	....	.....	.....	.....	.....	.....
6⅝....	7.52	6.58	5.72	5.17	4.62	3.91	....	.....	.....	.....	.....	.....
6¾....	7.66	6.71	5.83	5.26	4.70	3.98	....	.....	.....	.....	.....	.....
6⅞....	7.81	6.83	5.94	5.37	4.79	4.05	....	.....	.....	.....	.....	.....
7	7.95	6.96	6.05	5.46	4.88	4.13	....	.....	.....	.....	.....	.....
7⅛....	8.09	7.09	6.15	5.55	....	....	....	.....	.....	.....	.....	.....
7¼....	8.24	7.21	6.26	5.66	....	....	....	.....	.....	.....	.....	.....
7⅜....	8.39	7.34	6.37	5.75	....	....	....	.....	.....	.....	.....	.....
7½....	8.53	7.46	6.48	5.86	....	....	....	.....	.....	.....	.....	.....
7⅝....	8.67	7.59	6.59	5.95	....	....	....	.....	.....	.....	.....	.....
7¾....	8.82	7.72	6.70	6.05	....	....	....	.....	.....	.....	.....	.....
7⅞....	8.96	7.84	6.81	6.15	....	....	....	.....	.....	.....	.....	.....
8	9.10	7.96	6.92	6.25	....	....	....	.....	.....	.....	.....	.....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	13	14	15	16	17	18	19	20	21	22	23	24
Increase in lbs. per foot:	.2188	.1669	.1257	.1024	.0816	.0582	.0427	.0297	.0248	.0190	.0151	.0118

TABLE SHOWING WEIGHT PER FOOT OF

American or B. & S. Gauge.

Gauge No.	2	3	4	5	6	7	8	9	10	11	12	13
Thickness of each No. in decimal parts of inch :	.25763	.22942	.20431	.18194	.16202	.14428	.12849	.11443	.10189	.090742	.080808	.071961
Frac. of inch, corresponding closely to Gauge Nos.:	1/4	15/64	13/64	3/16	11/64	9/64	1/8	7/64	....	3/32	5/64	.....
Diameter Tubes, Inches.												
1/8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9/64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5/32	.....	.....	.....	.....	.....	.....	.....	.....	.....	.183	.175	.17	.16
11/64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.26	.24	.23	.21
3/16	.....	.....	.....	.....	.....	.....	.40	.38	.36	.34	.31	.28	.26
13/64	.....	.....	.....	.....	.....	.51	.48	.45	.41	.38	.35	.33
7/32	.....	.....	.....	.70	.66	.62	.58	.53	.49	.45	.41	.38
15/64	.....	.....	.....	.84	.79	.73	.67	.62	.57	.51	.47	.43
1/4	1.14	1.10	1.04	.98	.91	.84	.78	.70	.64	.59	.54	.48
17/64	1.34	1.27	1.20	1.11	1.03	.94	87	.80	.72	.66	.60	.54
9/32	1.53	1.45	1.35	1.25	1.15	1.06	.97	.88	.80	.72	.65	.59
19/64	1.73	1.63	1.50	1.39	1.28	1.17	1.06	.97	.87	.79	.71	.64
5/16	1.93	1.80	1.66	1.52	1.40	1.28	1.17	1.05	.96	.86	.78	.70
21/64	2.12	1.96	1.82	1.67	1.52	1.39	1.26	1.14	1.03	.93	.84	.76
1	2.32	2.14	1.97	1.81	1.65	1.49	1.35	1.23	1.11	1.00	.90	.81
1 1/16	2.71	2.49	2.28	2.08	1.89	1.71	1.55	1.40	1.26	1.13	1.02	.91
1 1/8	3.10	2.83	2.59	2.35	2.13	1.93	1.74	1.57	1.42	1.27	1.14	1.03
1 3/16	3.49	3.18	2.90	2.62	2.38	2.15	1.94	1.74	1.57	1.41	1.27	1.13
1 1/4	3.87	3.53	3.20	2.91	2.62	2.37	2.13	1.92	1.72	1.54	1.39	1.15
1 5/16	4.27	3.87	3.52	3.18	2.88	2.58	2.33	2.09	1.88	1.69	1.51	1.35
1 3/8	4.66	4.23	3.82	3.45	3.12	2.80	2.52	2.27	2.04	1.83	1.64	1.46
1 7/16	5.05	4.58	4.14	3.73	3.36	3.02	2.82	2.45	2.18	1.96	1.75	1.57
2	5.44	4.92	4.44	4.01	3.61	3.24	2.91	2.61	2.34	2.10	1.88	1.68
2 1/16	5.83	5.27	4.76	4.28	3.85	3.46	3.11	2.79	2.50	2.24	2.01	1.80
2 1/8	6.22	5.62	5.06	4.56	4.09	3.69	3.31	2.96	2.66	2.37	2.12	1.90
2 3/16	6.61	5.96	5.38	4.83	4.35	3.90	3.50	3.14	2.80	2.51	2.25	2.01
2 1/4	7.00	6.31	5.68	5.11	4.59	4.12	3.70	3.32	2.96	2.65	2.37	2.12
2 5/16	7.39	6.66	6.00	5.39	4.84	4.34	3.88	3.49	3.12	2.78	2.49	2.23
2 3/8	7.78	7.00	6.30	5.66	5.08	4.56	4.08	3.65	3.27	2.92	2.61	2.33
2 7/16	8.17	7.35	6.61	5.93	5.32	4.78	4.27	3.83	3.42	3.06	2.74	2.45
3	8.57	7.71	6.92	6.22	5.58	4.99	4.47	4.00	3.58	3.20	2.86	2.55
3 1/16	8.96	8.05	7.23	6.49	5.82	5.21	4.66	4.18	3.73	3.34	2.98	2.67
3 1/8	9.34	8.40	7.54	6.76	6.06	5.43	4.86	4.35	3.88	3.48	3.11	2.77
3 3/16	9.73	8.75	7.85	7.03	6.31	5.65	5.05	4.52	4.04	3.61	3.22	2.88
3 1/4	10.12	9.09	8.16	7.32	6.55	5.87	5.25	4.69	4.20	3.75	3.35	2.99
3 5/16	10.51	9.44	8.47	7.59	6.80	6.08	5.44	4.87	4.35	3.88	3.48	3.10
3 3/8	10.91	9.79	8.78	7.86	7.05	6.30	5.64	5.04	4.50	4.02	3.59	3.21
3 7/16	11.30	10.13	9.08	8.14	7.29	6.52	5.83	5.22	4.66	4.16	3.72	3.32

To determine weight per foot of a tube of a given Inside below under corre-

Gauge No.	2	3	4	5	6	7	8	9	10	11	12	13
Increase in lbs. per foot :	1.609	1.274	1.0119	.8024	.6364	.5046	.4001	.3174	.2517	.1996	.1583	.1255

"BRIDGEPORT" SEAMLESS *COPPER* TUBES

Measured in **Outside Diameters**

Gauge No.	14	15	16	17	18	19	20	21	22	23	24	25	26
Thickness of each No. in decimal parts of inch :	.064084	.057068	.05082	.045257	.040303	.03589	.031961	.028462	.025347	.022571	.0201	.0179	.01594
Frac. of inch, corresponding closely to Gauge Nos. :	1/16	....	....	3/64	....	.....	1/32	.....	.....	....	....	....	1/64
Diameter Tubes, Inches.													
1/8	....	.047	.045	.043	.041	.039	.036	.034	.029	.028	.025	.023	.021
5/16	.094	.090	.084	.073	.071	.065	.06	.056	.049	.045	.040	.037	.034
1/4	.15	.14	.13	.115	.10	.092	.084	.08	.068	.062	.056	.050	.045
5/16	.19	.18	.16	.15	.14	.12	.11	.10	.088	.08	.070	.064	.057
3/8	.24	.22	.20	.18	.16	.15	.13	.12	.107	.097	.086	.078	.069
7/16	.29	.26	.24	.21	.19	.18	.16	.14	.127	.113	.101	.091	.081
1/2	.34	.30	.27	.25	.22	.20	.18	.16	.146	.130	.117	.105	.093
9/16	.39	.35	.31	.28	.25	.23	.21	.18	.164	.148	.131	.119	.105
5/8	.44	.39	.36	.31	.28	.25	.23	.20	.183	.165	.147	.132	.118
11/16	.48	.44	.39	.35	.31	.28	.25	.23	.203	.182	.162	.146	.129
3/4	.54	.48	.43	.39	.35	.31	.27	.25	.226	.198	.177	.160	.142
13/16	.58	.52	.47	.42	.38	.34	.30	.27	.241	.216	.192	.172	.153
7/8	.63	.57	.50	.45	.41	.37	.33	.29	.26	.233	.208	.186	.166
15/16	.67	.61	.55	.49	.44	.39	.35	.31	.28	.25	.223	.199	.177
1	.72	.65	.59	.52	.47	.42	.38	.34	.30	.267	.238	.213	.190
1 1/16	.83	.73	.66	.60	.52	.47	.42	.38	.34	.312	.269	.240	....
1 1/4	.92	.83	.73	.66	.59	.52	.47	.42	.37	.336	.299	.268	....
1 3/16	1.02	.91	.82	.72	.65	.58	.52	.46	.41	.370	.330	.295	....
1 1/2	1.11	1.00	.89	.80	.71	.64	.57	.50	.45	.403	.360	.333	....
1 5/16	1.22	1.08	.97	.86	.78	.69	.62	.55	.49	.438	.391	....	....
1 3/4	1.31	1.18	1.05	.93	.83	.75	.66	.59	.52	.472	.421	....	....
1 7/8	1.41	1.26	1.12	1.00	.89	.80	.71	.64	.57	.506	.451	....	....
2	1.50	1.34	1.20	1.07	.96	.85	.77	.68	.61	.540	.482	....	....
2 1/16	1.61	1.43	1.28	1.14	1.02	.90	.81	.72	.64	.586	....	....	....
2 1/4	1.70	1.51	1.35	1.22	1.08	.97	.86	.77	.68	.609	....	....	....
2 3/16	1.80	1.61	1.43	1.28	1.13	1.02	.90	.81	.72	.643	....	....	....
2 1/2	1.89	1.69	1.51	1.34	1.20	1.07	.96	.85	.77	.676	....	....	....
2 5/16	1.99	1.77	1.59	1.42	1.26	1.12	1.01	.89	.80	....	....	....	....
2 3/4	2.09	1.86	1.66	1.48	1.32	1.18	1.05	.93	.84	....	....	....	....
2 7/8	2.18	1.95	1.74	1.55	1.39	1.23	1.10	.98	.87	.	....	....	....
3	2.28	2.04	1.82	1.62	1.45	1.29	1.14	1.02	.91	....	....	....	....
3 1/16	2.38	2.12	1.89	1.70	1.50	1.34	1.20	1.07	.96	....	....	....	....
3 1/4	2.48	2.20	1.97	1.76	1.56	1.40	1.25	1.11	.99	....	....	....	....
3 3/16	2.57	2.30	2.05	1.83	1.63	1.45	1.29	1.15	1.03	....	....	....	....
3 1/2	2.67	2.38	2.12	1.89	1.69	1.50	1.34	1.20	1.07	....	....	....	....
3 5/16	2.77	2.47	2.20	1.96	1.75	1.56	1.40	1.24	1.10	....	....	....	....
3 3/4	2.87	2.55	2.28	2.03	1.81	1.62	1.44	1.28	1.14	....	....	....	....
3 7/8	2.96	2.65	2.35	2.10	1.87	1.67	1.49	1.32	1.19	....	....	....	....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	14	15	16	17	18	19	20	21	22	23	24	25	26
Increase in lbs. per foot :	.0995	.0799	.0636	.0497	.0394	.0312	.0248	.0196	.0155	.0123	.0098	.0078	.0062

TABLE SHOWING WEIGHT PER FOOT OF

American or B. & S. Gauge,

Gauge No.	2	3	4	5	6	7	8	9	10	11
Thickness of each No. in decimal parts of inch :	.25763	.22942	.20431	.18194	.16202	.14428	.12849	.11443	.10189	.090742
Frac. of inch, corresponding closely to Gauge No.:	1/4	15/64	13/64	3/16	11/64	9/64	1/8	7/64	.....	5/32
Diameter Tubes, inches.										
4	11.69	10.48	9.40	8.42	7.54	6.74	6.03	5.39	4.81	4.29
4⅛....	12.07	10.82	9.70	8.69	7.78	6.96	6.23	5.56	4.97	4.43
4¼....	12.46	11.18	10.02	8.97	8.02	7.18	6.42	5.73	5.12	4.57
4⅜....	12.85	11.53	10.32	9.24	8.27	7.39	6.61	5.91	5.27	4.71
4½....	13.25	11.88	10.64	9.52	8.52	7.61	6.80	6.08	5.43	4.85
4⅝....	13.64	12.22	10.94	9.80	8.77	7.83	7.00	6.26	5.59	4.99
4¾....	14.03	12.57	11.26	10.07	9.01	8.05	7.19	6.43	5.74	5.12
4⅞....	14.42	12.91	11.56	10.34	9.25	8.27	7.39	6.60	5.89	5.26
5	14.80	13.26	11.88	10.62	9.50	8.48	7.58	6.77	6.05	5.40
5⅛....	15.19	13.61	12.18	10.89	9.74	8.70	7.78	6.95	6.21	5.53
5¼....	15.59	13.95	12.49	11.17	9.99	8.92	7.97	7.12	6.35	5.67
5⅜....	15.98	14.30	12.80	11.44	10.24	9.15	8.17	7.30	6.51	5.81
5½....	16.37	14.66	13.11	11.73	10.48	9.37	8.37	7.46	6.67	5.94
5⅝....	16.76	15.00	13.42	12.00	10.73	9.58	8.56	7.64	6.81	6.08
5¾....	17.15	15.35	13.73	12.27	10.97	9.80	8.76	7.81	6.97	6.22
5⅞....	17.55	15.70	14.04	12.55	11.21	10.02	8.95	7.99	7.13	6.36
6	17.93	16.04	14.35	12.83	11.47	10.24	9.15	8.16	7.29	6.50
6⅛....	18.32	16.39	14.66	13.10	11.71	10.46	9.33	8.34	7.43	6.64
6¼....	18.71	16.74	14.97	13.38	11.95	10.68	9.53	8.50	7.59	6.77
6⅜....	19.10	17.01	15.28	13.65	12.20	10.89	9.72	8.68	7.75	6.91
6½....	19.49	17.43	15.58	13.93	12.44	11.11	9.92	8.85	7.90	7.05
6⅝....	19.89	17.78	15.90	14.21	12.69	11.33	10.11	9.03	8.05	7.18
6¾....	20.28	18.13	16.20	14.48	12.94	11.55	10.31	9.21	8.21	7.32
6⅞....	20.66	18.48	16.52	14.75	13.18	11.76	10.50	9.38	8.36	7.45
7	21.05	18.83	16.82	15.04	13.43	11.98	10.70	9.55	8.52	7.59
7⅛....	21.44	19.17	17.14	15.31	13.67	12.20	10.90	9.72	8.67	7.73
7¼....	21.83	19.52	17.44	15.58	13.91	12.42	11.09	9.90	8.83	7.87
7⅜....	22.23	19.87	17.76	15.86	14.16	12.64	11.29	10.07	8.98	8.01
7½....	22.62	20.21	18.06	16.14	14.41	12.86	11.48	10.25	9.13	8.15
7⅝....	23.01	20.56	18.37	16.41	14.66	13.07	11.68	10.42	9.29	8.28
7¾....	23.39	20.91	18.68	16.68	14.90	13.29	11.86	10.59	9.44	8.42
7⅞....	23.78	21.25	18.99	16.96	15.14	13.51	12.06	10.76	9.60	8.56
8	24.18	21.61	19.30	17.24	15.39	13.73	12.25	10.94	9.75	8.69

To determine weight per foot of a tube of a given Inside

below under corre-

Gauge No.	2	3	4	5	6	7	8	9	10	11
Increase in lbs. per foot :	1.609	1.274	1.0119	.8024	.6364	.5046	.4001	.3174	.2517	.1996

"BRIDGEPORT" SEAMLESS *COPPER* TUBES

Measured in **Outside Diameters**

Gauge No.	12	13	14	15	16	17	18	19	20	21	22	23
Thickness of each No. in decimal parts of inch :	.080808	.071961	.064084	.057068	.05082	.045257	.040303	.03589	.031961	.028462	.025347	.022571
Frac. of inch, corresponding closely to Gauge No. :	5/64	....	1/16	.....	.....	3/64	.....	.....	1/32	.....	.....	.....
Diameter Tubes, Inches.												
4	3.84	3.42	3.06	2.73	2.44	2.16	1.93	1.72	1.53	1.36	1.22	....
4⅛....	3.96	3.54	3.16	2.81	2.51	2.25	1.99	1.77	1.59	1.41	.....	.....
4¼....	4.08	3.64	3.25	2.90	2.58	2.31	2.06	1.83	1.63	1.46	.....	.....
4⅜....	4.21	3.76	3.35	2.98	2.67	2.37	2.11	1.89	1.68	1.50	.....	.....
4½....	4.33	3.86	3.44	3.08	2.74	2.44	2.17	1.94	1.72	1.54	.....	.....
4⅝....	4.45	3.97	3.55	3.16	2.81	2.51	2.24	1.99	1.77	.....	.....	.....
4¾....	4.58	4.08	3.64	3.24	2.90	2.58	2.30	2.05	1.83	.....	.....	.....
4⅞....	4.69	4.19	3.74	3.33	2.97	2.65	2.36	2.10	1.88	.....	.....	.....
5	4.82	4.29	3.83	3.42	3.04	2.72	2.43	2.15	1.92	.....	.....	.....
5⅛....	4.95	4.41	3.94	3.51	3.13	2.79	2.48	2.22	.....	.....	.....	.....
5¼....	5.06	4.51	4.03	3.59	3.20	2.86	2.54	2.27	.....	.....	.....	.....
5⅜....	5.19	4.63	4.13	3.67	3.28	2.92	2.60	2.32	.....	.....	.....	.....
5½....	5.31	4.74	4.22	3.77	3.36	2.99	2.67	2.37	.....	.....	.....	.....
5⅝....	5.43	4.84	4.33	3.85	3.43	3.06	2.73	.....	.....	.....	.....	.....
5¾....	5.55	4.96	4.42	3.94	3.51	3.13	2.78	.....	.....	.....	.....	.....
5⅞....	5.68	5.06	4.51	4.02	3.59	3.19	2.85	.....	.....	.....	.....	.....
6	5.80	5.18	4.61	4.12	3.66	3.27	2.91	.....	.....	.....	.....	.....
6⅛....	5.92	5.28	4.71	4.20	3.75	....	....	.....	.....	.....	.....	.....
6¼....	6.05	5.39	4.81	4.28	3.82	....	....	.....	.....	.....	.....	.....
6⅜....	6.16	5.50	4.90	4.37	3.90	....	....	.....	.....	.....	.....	.....
6½....	6.29	5.61	5.00	4.46	3.97	....	....	.....	.....	.....	.....	.....
6⅝....	6.42	5.72	5.10	4.55	4.04	....	....	.....	.....	.....	.....	.....
6¾....	6.53	5.83	5.20	4.63	4.13	....	....	.....	.....	.....	.....	.....
6⅞....	6.66	5.93	5.29	4.71	4.21	....	....	.....	.....	.....	.....	.....
7	6.78	6.05	5.39	4.80	4.28	...	....	.....	.....	.....	.....	.....
7⅛....	6.90	6.15	5.49	....	....	....	....	.....	.....	.....	.....	.....
7¼....	7.02	6.26	5.59	....	....	....	....	.....	.....	.....	.....	.....
7⅜....	7.14	6.37	5.68	....	....	....	....	.....	.....	.....	.....	.....
7½....	7.27	6.48	5.77	....	....	....	....	.....	.....	.....	.....	.....
7⅝....	7.39	6.59	5.88	....	....	....	....	.....	.....	.....	.....	.....
7¾....	7.51	6.70	5.97	....	....	....	....	.....	.....	.....	.....	.....
7⅞....	7.63	6.80	6.07	....	....	....	....	.....	.....	.....	.....	.....
8	7.76	6.92	6.16	....	....	....	....	.....	.....	.....	.....	.....

Diameter, add to weights in above list the weights given sponding gauge numbers.

Gauge No.	12	13	14	15	16	17	18	19	20	21	22	23
Increase in lbs. per foot :	.1582	.1255	.0995	.0790	.0626	.0497	.0394	.0312	.0248	.0196	.0155	.0123

TABLE SHOWING MEASUREMENTS FOR PIPE THREADING IN ACCORDANCE WITH THE ROBERT BRIGGS STANDARD

Adapted from data given in "American Machinists' Handbook," Colvin and Stanley Edition.

Diam. of Pipe, Inches			No. of Threads per Inch	Diam. at End of Pipe Inches	Diam. at Bottom of Thread Inches	Depth of Thread Inches	Length of Perfect Threads Inches	No. of Perfect Threads	Total Length of Thread and Thickness of Die, Ins.	No. of Turns Pipe Screws into Fitting by Hand	Diam. Drill to be used with Pipe Reamer Inches
Nominal Inside	Actual Inside	Actual Outside									
1/8	.270	.405	27	.393	.334	.029	.19	5.13	.412	4	11/64
1/4	.364	.540	18	.522	.433	.044	.29	5.22	.624	4	7/16
3/8	.494	.675	18	.656	.568	.044	.30	5.4	.634	4	19/32
1/2	.623	.840	14	.815	.701	.057	.39	5.46	.818	4	11/16
3/4	.824	1.050	14	1.025	.911	.057	.40	5.6	.828	4	29/32
1	1.048	1.315	11 1/2	1.283	1.144	.069	.51	5.87	1.03	4 1/2	1 5/32
1 1/4	1.380	1.660	11 1/2	1.626	1.488	.069	.54	6.21	1.06	5	1 1/2
1 1/2	1.610	1.900	11 1/2	1.866	1.728	.069	.55	6.33	1.07	5	1 23/32
2	2.067	2.375	11 1/2	2.339	2.201	.069	.58	6.67	1.10	5	2 1/4
2 1/2	2.468	2.875	8	2.819	2.619	.100	.89	7.12	1.64	5	2 3/4
3	3.067	3.500	8	3.441	3.241	.100	.95	7.6	1.70	5	3 5/16
3 1/2	3.548	4.000	8	3.938	3.738	.100	1.00	8.0	1.75	5	3 13/16
4	4.026	4.500	8	4.434	4.234	.100	1.05	8.4	1.80	5 1/2	4 5/16
4 1/2	4.508	5.	8	4.931	4.731	.100	1.10	8.8	1.85	5 1/2	...
5	5.045	5.563	8	5.490	5.290	.100	1.16	9.28	1.91	5 1/2	...
6	6.065	6.625	8	6.546	6.346	.100	1.26	10.08	2.01	6	...
7	7.023	7.625	8	7.540	7.340	.100	1.36	10.88	2.11	7	...
8	7.982	8.625	8	8.534	8.334	.100	1.46	11.68	2.21	8	...
9	9.000	*9.625	8	9.527	9.327	.100	1.57	12.56	2.32	9	...
10	10.019	10.750	8	10.645	10.445	.100	1.68	13.44	2.43	10	...

* By action of Manufacturers of Wrought Iron Pipe and Boiler Tubes, May 9, 1889, this figure 9.625 O. D. for 9-inch pipe was adopted inplace of 9.688, printed in earlier tables.

Specific Gravity, Weight and Tensile Strength of Bridgeport Seamless Brass and Copper Tubing

	Weight per Cu. Inch Pounds	Weight per Cu. Foot Pounds	Specific Gravity	Tensile Strength per Sq. In. Pounds
Brass	.3069	530.3	8.495	40,000
Copper	.3227	557.6	8.932	30,000

FORMULA FOR CALCULATING COLLAPSING PRESSURE OF MODERN LAP-WELDED BESSEMER STEEL TUBES

[*Approximately True for Brass*]

From Experiments at National Tube Works and reported in Vol. XXVII Trans. A.S.M.E.

$$P = 1{,}000 \left(1 - \sqrt{1 - \frac{1{,}600\, t^2}{d^2}}\right) \quad . \ . \ . \ \text{(A)}$$

$$P = 86{,}670 \frac{t}{d} - 1{,}386 \quad . \ . \ . \ . \ . \ \text{(B)}$$

Where P = collapsing pressure, pounds per sq. inch.
d = outside diameter of tube in inches.
t = thickness of wall in inches.

Formula A is of for values of P less than 581 pounds, or for values of t/d less than 0.023, while formula B is for values greater than these.

FORMULA FOR DETERMINING THE PROPER THICKNESS OF COPPER PIPES

(*Prescribed by Board of Supervising Inspectors of Steamboats*)

The thickness of material, according to the working pressure, shall be determined by the following formula:

This proviso shall not apply to copper pipe contracted for previous to June 1, 1911.

$$T = \frac{P \times D}{6{,}000} + .0625.$$

Where T = thickness in inches.
P = working pressure.
D = inside diameter of pipe in inches.

EXAMPLE: Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch.
Substituting and solving, we have

$$T = \frac{175 \times 5}{6{,}000} + .0625 = .208.$$

SCHEDULE OF STANDARD FLANGES

Adopted October 25, 1911, by a Committee of the National Association of Master Steam and Hot Water Fitters and of The American Society of Mechanical Engineers

For Steam Pressures up to 125 lb. per sq. in.

All dimensions are in inches

Size of Pipe	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Size of Bolts	Diameter of Bolt Holes
1	4	7/16	3	4	7/16	9/16
1¼	4½	½	3⅜	4	7/16	9/16
1½	5	9/16	3⅞	4	½	⅝
2	6	⅝	4¾	4	⅝	¾
2½	7	11/16	5½	4	⅝	¾
3	7½	¾	6	4	⅝	¾
3½	8½	13/16	7	4	⅝	¾
4	9	15/16	7½	8	¾	⅞
4½	9¼	15/16	7¾	8	¾	⅞
5	10	15/16	8½	8	¾	⅞
6	11	1	9½	8	¾	⅞
7	12½	1 1/16	10¾	8	¾	⅞
8	13½	1⅛	11¾	8	¾	⅞
9	15	1⅛	13¼	12	¾	⅞
10	16	1 3/16	14¼	12	⅞	1
12	19	1¼	17	12	⅞	1
14 O.D.	21	1⅜	18¾	12	1	1⅛
15 O.D.	22¼	1⅜	20	16	1	1⅛
16 O.D.	23½	1 7/16	21¼	16	1	1⅛
18 O.D.	25	1 9/16	22¾	16	1⅛	1¼
20 O.D.	27½	1 11/16	25	20	1⅛	1¼
22 O.D.	29½	1 13/16	27¼	20	1⅛	1¼
24 O.D.	32	1⅞	29½	20	1⅛	1¼
26 O.D.	34¼	2	31¾	24	1¼	1⅜
28 O.D.	36½	2 1/16	34	28	1¼	1⅜
30 O.D.	38¾	2⅛	36	28	1⅜	1½

Bolt holes should straddle center lines.
Flanges should be plain faced.

SCHEDULE OF EXTRA HEAVY FLANGES

Adopted October 25, 1911, by a Committee of the National Association of Master Steam and Hot Water Fitters and of The American Society of Mechanical Engineers

For Steam Pressures from 125 to 250 lb. per. sq. in.

All dimensions are in inches

Size of Pipe	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Size of Bolts	Diameter of Bolt Holes
1	4½	11/16	3¼	4	½	5/8
1¼	5	¾	3¾	4	½	5/8
1½	6	13/16	4½	4	5/8	¾
2	6½	⅞	5	4	5/8	¾
2½	7½	1	5⅞	4	¾	⅞
3	8¼	1⅛	6⅝	8	¾	⅞
3½	9	1 3/16	7¼	8	¾	⅞
4	10	1¼	7⅞	8	¾	⅞
4½	10½	1 5/16	8½	8	¾	⅞
5	11	1⅜	9¼	8	¾	⅞
6	12½	1 7/16	10⅝	12	¾	⅞
7	14	1½	11⅞	12	⅞	1
8	15	1⅝	13	12	⅞	1
9	16¾	1¾	14	12	1	1⅛
10	18¼	1⅞	15¾	16	1	1⅛
12	20¾	2	17¾	16	1⅛	1¼
14 O.D.	23½	2⅛	20¼	20	1¼	1⅜
15 O.D.	25	2 3/16	21½	20	1¼	1⅜
16 O.D.	26	2¼	22½	20	1⅜	1½
18 O.D.	28½	2⅜	24¾	24	1⅜	1½
20 O.D.	31	2½	27	24	1½	1⅝
22 O.D.	33	2⅝	29¼	28	1½	1⅝
24 O.D.	36	2¾	32	28	1⅝	1¾

Bolt Holes should straddle center lines.
Flanges should have 1/16 inch raised face for gaskets.
Square Head Bolts with hexagonal nuts are recommended.

REPORT OF COMMITTEE ON IDENTIFICATION OF POWER HOUSE PIPING—Revise 1305

a In the main engine rooms of plants which are well lighted, and where the functions of the exposed pipes are obvious, all pipes shall be painted to conform to the color scheme of the room; and if it is desirable to distinguish pipe systems, colors shall be used only on flanges and on valve fitting flanges.

b In all other parts of the plant, such as boiler house, basements, etc., all pipes (exclusive of valves, flanges and fittings), except the fire system, shall be painted black, or some other single, plain, durable, inexpensive color.

c All fire lines (suction and discharge), including pipe lines, valve flanges and fittings, shall be painted red throughout.

d The edges of all flanges, fittings or valve flanges on pipe lines larger than 4 in. inside diameter, and the entire fittings, valves and flanges on lines 4 in. inside diameter and smaller, shall be painted the following distinguishing colors, numbered 1 to 12, inclusive:

Distinguishing Colors to be Used on Valves, Flanges and Fittings Only

STEAM DIVISION

a High pressure — *White*
b Exhaust system — *Buff*

WATER DIVISION

c Fresh water, low pressure — *Blue*
d Fresh water, high pressure boiler feed lines — *Blue and White*
e Salt water piping — *Green*

OIL DIVISION

f Delivery and discharge—brass or bronze — *Yellow*

PNEUMATIC DIVISION

g All pipes — *Gray*

GAS DIVISION

h City lighting service — *Aluminum*
i Gas engine service — *Black, red flanges*

FUEL OIL DIVISION

j All piping — *Black*

REFRIGERATING SYSTEM

k White and green stripes alternately on flanges and fittings — *Body of pipe being black*

ELECTRIC LINES AND FEEDERS.

l Black and red stripes alternately on flanges and fittings — *Body of pipe being black*

Respectfully submitted,

F. R. HUTTON — H. P. NORTON
I. E. MOULTROP — J. T. WHITTLESEY
H. G. STOTT, *Chairman*

RULES AND REGULATIONS FOR THE USE OF SEAMLESS BRASS AND COPPER TUBES, AS PRESCRIBED BY THE BOARD OF SUPERVISING INSPECTORS OF STEAMBOATS

[Amended to September 25th, 1912]

Copper and Brass Tubes May be Used in Construction of Water Tube Boilers When Liquid Fuel is Used

Seamless copper or brass tubes not exceeding three-fourths of an inch in diameter may be used in the construction of water-tube boilers or generators when liquid fuel is used.

There may also be used in their construction.

Copper or brass steam drums not exceeding 14 inches in diameter, of a thickness of material not less than five-eighths of an inch.

And copper or brass steam drums 12 inches in diameter and under having a thickness of material of not less than one-half inch.

All tubes and drums referred to in this paragraph shall be made from ingots or blanks drawn down to size without a seam.

Water-tube boilers or generators so constructed may be used for marine purposes with none other than liquid fuel. (Sec. 4429, R. S.)

Flanging of Copper Tubes

All copper pipe subject to pressure shall be flanged over or outward to a depth of not less than twice the thickness of the material in the pipe, and such flanging shall be made to a radius not to exceed the thickness of the pipe.

On boilers whose construction was commenced after June 30, 1905, no bend will be allowed in copper pipe of which the radius is less than one and one-half times the diameter of the pipe, and such pipe must be so led and flanges so placed that they may be readily taken down if required.

Such pipes must be protected by iron casings when run through coal bunkers, and must be clear of the coal chutes.

The flanges of all copper steam pipes over 3 inches in diameter shall be made of brass or bronze composition, forged iron or steel, or open-hearth steel castings, and shall be securely brazed or riveted to the pipe.

Provided, however, That when such pipes are properly formed with a taper through the flange, such taper being fully reenforced, the riveting or brazing may be dispensed with:

And provided also, That when the pipe has been expanded by proper and capable machinery into grooved flanges and the pipe flared out at the ends to an angle of approximately 20°, said angle to be taken in the direction of the length of the pipe, and having a depth of flare equal to at least one and one-half times the thickness of the material in the pipe, said riveting or brazing may be dispensed with.

Where copper pipes are expanded into or riveted to flanges, it will be necessary for the pipes with their flanges attached to withstand a hydrostatic pressure of two and one-half times the boiler pressure.

Flanges shall be not less than four times the required thickness of pipe, plus one-fourth of an inch, and shall be fitted with such number of good and substantial bolts as shall make the joints at least equal in strength to all other parts of the pipe.

Any form of joint that will add to the safety or increase the strength of flange and pipe connections over those provided for by this rule will be allowed on any and all classes of steam pipe.

Water Conversion Factors

U. S. gallons	x	8.33	= pounds
U. S. gallons	x	0.13368	= cubic feet
U. S. gallons	x	231	= cubic inches
U. S. gallons	x	0.83	= English gallons
U. S. gallons	x	3.78	= liters
English gallons (Imperial)	x	10	= pounds
English gallons (Imperial)	x	0.16	= cubic feet
English gallons (Imperial)	x	277.274	= cubic inches
English gallons (Imperial)	x	1.2	= U. S. gallons
English gallons (Imperial)	x	4.537	= liters
Cubic inches of water (39.1°)	x	0.036024	= pounds
Cubic inches of water (39.1°)	x	0.004329	= U. S. gallons
Cubic inches of water (39.1°)	x	0.003607	= English gallons
Cubic inches of water (39.1°)	x	0.576384	= ounces
Cubic feet of water (39.1°)	x	62.425	= pounds
Cubic feet of water (39.1°)	x	7.48	= U. S. gallons
Cubic feet of water (39.1°)	x	6.232	= English gallons
Cubic feet of water (39.1°)	x	0.028	= tons
Pounds of water	x	27.72	= cubic inches
Pounds of water	x	0.01602	= cubic feet
Pounds of water	x	0.083	= U. S. gallons
Pounds of water	x	0.10	= English gallons

TABLE SHOWING FRACTIONS OF INCH REDUCED TO DECIMAL EQUIVALENTS

64ths.	32ds.	16ths.	8ths.	Decimal Equivalents:
1/64				.015625
	1/32			.031250
3/64				.046875
		1/16		.062500
5/64				.073125
	3/32			.093750
7/64				.109375
			1/8	.125000
9/64				.140625
	5/32			.156250
11/64				.171875
		3/16		.187500
13/64				.203125
	7/32			.218750
15/64				.234375
			2/8	.250000
17/64				.265625
	9/32			.281250
19/64				.296875
		5/16		.312500
21/64				.328125
	11/32			.343750
23/64				.359375
			3/8	.375000
25/64				.390625
	13/32			.406250
27/64				.421875
		7/16		.437500
29/64				.453125
	15/32			.468750
31/64				.484375
			4/8	.500000
33/64				.515625
	17/32			.531250
35/64				.546875
		9/16		.562500
37/64				.578125
	19/32			.593750
39/64				.609375
			5/8	.625000
41/64				.640625
	21/32			.656250
43/64				.671875
		11/16		.687500
45/64				.703125
	23/32			.718750
47/64				.734375
			6/8	.750000
49/64				.765625
	25/32			.781250
51/64				.796875
		13/16		.812500
53/64				.828125
	27/32			.843750
55/64				.859375
			7/8	.875000
57/64				.890625
	29/32			.906250
59/64				.921875
		15/16		.937500
61/64				.953125
	31/32			.968750
63/64				.984375

TABLE OF EQUIVALENTS OF FRACTIONS OF MILLIMETERS IN DECIMALS OF INCHES

mm.	inches	mm.	inches	mm.	inches
1/100	.0003937	45/100	.01772	89/100	.03504
2/100	.00079	46/100	.01811	90/100	.03543
3/100	.00118	47/100	.01851	91/100	.03583
4/100	.00157	48/100	.01890	92/100	.03622
5/100	.00197	49/100	.01928	93/100	.03662
6/100	.00236	50/100	.01969	94/100	.03701
7/100	.00276	51/100	.02008	95/100	.03740
8/100	.00315	52/100	.02047	96/100	.03780
9/100	.00354	53/100	.02087	97/100	.03819
10/100	.00394	54/100	.02126	98/100	.03858
11/100	.00433	55/100	.02165	99/100	.03898
12/100	.00472	56/100	.02205	1	.03937
13/100	.00512	57/100	.02244	2	.07874
14/100	.00551	58/100	.02284	3	.11811
15/100	.00591	59/100	.02323	4	.15748
16/100	.00630	60/100	.02362	5	.19685
17/100	.00669	61/100	.02402	6	.23622
18/100	.00709	62/100	.02441	7	.27559
19/100	.00748	63/100	.02480	8	.31496
20/100	.00787	64/100	.02520	9	.35433
21/100	.00827	65/100	.02559	10	.39370
22/100	.00866	66/100	.02598	11	.43307
23/100	.00906	67/100	.02638	12	.47244
24/100	.00945	68/100	.02677	13	.51181
25/100	.00984	69/100	.02717	14	.55118
26/100	.01024	70/100	.02756	15	.59055
27/100	.01063	71/100	.02795	16	.62992
28/100	.01102	72/100	.02835	17	.66929
29/100	.01142	73/100	.02874	18	.70866
30/100	.01181	74/100	.02914	19	.74803
31/100	.01220	75/100	.02953	20	.78740
32/100	.01260	76/100	.02992	21	.82677
33/100	.01299	77/100	.03032	22	.86614
34/100	.01339	78/100	.03071	23	.90551
35/100	.01378	79/100	.03110	24	.94488
36/100	.01417	80/100	.03150	25	.98425
37/100	.01457	81/100	.03189	26	1.02362
38/100	.01496	82/100	.03228	27	1.06299
39/100	.01535	83/100	.03268	28	1.10236
40/100	.01575	84/100	.03307	29	1.14173
41/100	.01614	85/100	.03347	30	1.18110
42/100	.01654	86/100	.03386	31	1.22047
43/100	.01693	87/100	.03425	32	1.25984
44/100	.01732	88/100	.03465	33	1.29921

1 mm. = ...03937 In.
10 mm. = 1 Centimeter = 0.3937 In.
10 cm. = 1 Decimeter = 3.937 In.

10 m. = 1 Meter = ...39.37 In.
25.4 mm. = ...1 English In.

TABLE OF EQUIVALENTS OF MILLIMETERS IN DECIMALS OF INCHES

mm.	inches	mm.	inches	mm.	inches
34	1.33858	78	3.07086	122	4.80314
35	1.37795	79	3.11023	123	4.84251
36	1.41732	80	3.14960	124	4.88188
37	1.45669	81	3.18897	125	4.92125
38	1.49606	82	3.22834	126	4.96062
39	1.53543	83	3.26771	127	4.99999
40	1.57480	84	3.30708	128	5.03936
41	1.61417	85	3.34645	129	5.07873
42	1.65354	86	3.38582	130	5.11810
43	1.69291	87	3.42519	131	5.15747
44	1.73228	88	3.46456	132	5.19684
45	1.77165	89	3.50393	133	5.23621
46	1.81102	90	3.54330	134	5.27558
47	1.85039	91	3.58267	135	5.31495
48	1.88976	92	3.62204	136	5.35432
49	1.92913	93	3.66141	137	5.39369
50	1.96850	94	3.70078	138	5.43306
51	2.00787	95	3.74015	139	5.47243
52	2.04724	96	3.77952	140	5.51180
53	2.08661	97	3.81889	141	5.55117
54	2.12598	98	3.85826	142	5.59054
55	2.16535	99	3.89763	143	5.62991
56	2.20472	100	3.93700	144	5.66928
57	2.24409	101	3.97637	145	5.70865
58	2.28346	102	4.01574	146	5.74802
59	2.32283	103	4.05511	147	5.78739
60	2.36220	104	4.09448	148	5.82676
61	2.40157	105	4.13385	149	5.86613
62	2.44094	106	4.17322	150	5.90550
63	2.48031	107	4.21259	151	5.94487
64	2.51968	108	4.25196	152	5.98424
65	2.55905	109	4.29133	153	6.02361
66	2.59842	110	4.33070	154	6.06298
67	2.63779	111	4.37007	155	6.10235
68	2.67716	112	4.40944	156	6.14172
69	2.71653	113	4.44881	157	6.18109
70	2.75590	114	4.48818	158	6.22046
71	2.79527	115	4.52755	159	6.25983
72	2.83464	116	4.56692	160	6.29920
73	2.87401	117	4.60629	161	6.33857
74	2.91338	118	4.64566	162	6.37794
75	2.95275	119	4.68503	163	6.41731
76	2.99212	120	4.72440	164	6.45668
77	3.03149	121	4.76377	165	6.49605

1 mm. = ...03937 In.	10 m. = 1 Meter = ...39.37 In.
10 mm. = 1 Centimeter = 0.3937 In.	25.4 mm. = ...1 English In.
10 cm. = 1 Decimeter = 3.937 In.	

HEAD IN FEET OF WATER, CORRESPONDING TO PRESSURES IN POUNDS PER SQUARE INCH AT 62° F

One Pound per Square Inch = 2.30947 Feet Head

One Atmosphere = 14.7 lbs. per Square Inch = 33.94 Feet Head

Pressure Lbs.	Head in Feet									
	0	1	2	3	4	5	6	7	8	9
0		2.309	4.619	6.928	9.238	11.547	13.857	16.166	18.476	20.785
10	23.0947	25.404	27.714	30.023	32.333	34.642	36.952	39.261	41.570	43.880
20	46.1894	48.499	50.808	53.118	55.427	57.737	60.046	62.356	64.665	66.975
30	69.2841	71.594	73.903	76.213	78.522	80.831	83.141	85.450	87.760	90.069
40	92.3788	94.688	96.998	99.307	101.62	103.93	106.24	108.55	110.85	113.16
50	115.4735	117.78	120.09	112.40	124.71	127.02	129.33	131.64	133.95	136.26
60	138.5682	140.88	143.19	145.50	147.81	150.12	152.42	154.73	157.04	159.35
70	161.6629	163.97	166.28	168.59	170.90	173.21	175.52	177.83	180.04	182.45
80	184.7576	187.07	189.38	191.69	194.00	196.31	198.61	200.92	203.23	205.54
90	207.8523	210.16	212.47	214.78	217.09	219.40	221.71	224.02	226.33	228.64

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER AT 62° F

The pressure of still water in pounds per square inch against the sides of any pipe, channel or vessel of any shape whatever is due solely to the "head," or height of the level surface of the water above the point at which the pressure is considered, and is equal to .43302 lb. per square inch for every foot of head, or 62.355 lbs. per square foot for every foot of head (at 62 degrees F.)

Head, Feet	Square Inches									
	0	1	2	3	4	5	6	7	8	9
0	.....	0.433	0.866	1.299	1.732	2.165	2.598	3.031	3.464	3.897
10	4.330	4.763	5.196	5.629	6.062	6.495	6.928	7.361	7.794	8.227
20	8.660	9.093	9.526	9.959	10.392	10.825	11.258	11.691	12.124	12.557
30	12.990	13.423	13.856	14.289	14.722	15.155	15.588	16.021	16.454	16.887
40	17.320	17.753	18.186	18.619	19.052	19.485	19.918	20.351	20.784	21.217
50	21.650	22.083	22.516	22.949	23.382	23.815	24.248	24.681	25.114	25.547
60	25.980	26.413	26.846	27.279	27.712	28.145	28.578	29.011	29.444	29.877
70	30.310	30.743	31.176	31.609	32.042	32.475	32.908	33.341	33.774	34.207
80	34.640	35.073	35.506	35.939	36.372	36.805	37.238	37.671	38.104	38.537
90	38.970	39.403	39.836	40.269	40.702	41.135	41.568	42.001	42.436	42.867

FLOW OF WATER IN CIRCULAR PIPES PER CUBIC FOOT PER SECOND

Based on Clean Pipes of Interior Diameters of ⅜ to 12 Inches. (Arranged from D'Arcy's Formula Q = Ac. Vr/Vs.)

Value of ac $\sqrt{r}$	Diameter Incher	Slope, or Head Divided by Length of Pipe							
		1 in 10	1 in 20	1 in 40	1 in 60	1 in 80	1 in 100	1 in 150	1 in 200
.00403	⅜	.00127	.00090	.00064	.00052	.00045	.00040	.00033	.00028
.00914	½	.00289	.00204	.00145	.00118	.00102	.00091	.00075	.00065
.02855	¾	.00903	.00638	.00451	.00369	.00319	.00286	.00233	.00202
.06334	1	.02003	.01416	.01001	.00818	.00708	.00633	.00517	.00448
.11659	1¼	.03687	.02607	.01843	.01505	.01303	.01166	.00952	.00824
.19155	1½	.06044	.04274	.03022	.02468	.02137	.01912	.01561	.01352
.28936	1¾	.09140	.06470	.04575	.03736	.03235	.02894	.02363	.02046
.41357	2	.13077	.09247	.06539	.05339	.04624	.04136	.03377	.02927
.74786	2½	.23647	.16722	.11824	.09655	.08361	.07479	.06106	.05288
1.2089	3	.38225	.27031	.19113	.15607	.13515	.12089	.09871	.08548
2.5630	4	.81042	.57309	.40521	.33088	.28654	.25630	.20927	.18123
4.5610	5	1.4422	1.0198	.72109	.58882	.50992	.45610	.37241	.32251
7.3068	6	2.3104	1.6338	1.1552	.94331	.81690	.73068	.59660	.51666
10.852	7	3.4314	2.4265	1.7157	1.4110	1.2132	1.0852	.88607	.76734
15.270	8	4.8284	3.4143	2.4141	1.9713	1.7072	1.5270	1.2468	1.0797
20.652	9	6.5302	4.6178	3.2651	2.6662	2.3089	2.0652	1.6862	1.4603
26.952	10	8.5222	6.0265	4.2611	3.4795	3.0132	2.6952	2.2006	1.9058
34.428	11	10.886	7.6981	5.4431	4.4447	3.8491	3.4428	2.8110	2.4344
42.918	12	13.571	9.5965	6.7853	5.5407	4.7982	4.2918	3.5043	3.0347
Value of $\sqrt{s}$ =		.3162	.2236	.1581	.1291	.1118	.1	.08165	.07071

QUANTITY OF WATER IN CU. FT. PER MINUTE DICHARGED FROM HOUSE SERVICE PIPES

It is assumed that Pipes are Straight and Smooth Inside.
From Data Furnished Thompson Meter Co. by E. Kuichling, C. E.

Pressure in Main Pounds per Sq In	Nominal Diameter of Pipes in Inches								
	½	⅝	¾	1	1½	2	3	4	6
Through 35 ft. of Service Pipe, no Back Pressure									
30	1.10	1.92	3.01	6.13	16.58	33.34	88.16	173.85	444.63
40	1.27	2.22	3.48	7.08	19.14	38.50	101.80	200.75	513.42
50	1.42	2.48	3.89	7.92	21.40	43.04	113.82	224.44	574.02
60	1.56	2.71	4.26	8.67	23.44	47.15	124.68	245.87	628.81
75	1.74	3.03	4.77	9.70	26.21	52.71	139.39	274.89	703.03
100	2.01	3.50	5.50	11.20	30.27	60.87	160.96	317.41	811.79
130	2.29	3.99	6.28	12.77	34.51	69.40	183.52	361.91	925.58
Through 100 ft. of Service Pipe, no Back Pressure									
30	0.66	1.16	1.84	3.78	10.40	21.30	58.19	118.13	317.23
40	0.77	1.34	2.12	4.36	12.01	24.59	67.19	136.41	366.30
50	0.86	1.50	2.37	4.88	13.43	27.50	75.13	152.51	409.54
60	0.94	1.65	2.60	5.34	14.71	30.12	82.30	167.06	448.63
75	1.05	1.84	2.91	5.97	16.45	33.68	92.01	186.78	501.58
100	1.22	2.13	3.36	6.90	18.99	38.89	106.24	215.68	579.18
130	1.39	2.42	3.83	7.86	21.66	44.34	121.14	245.91	660.36
Through 100 ft. of Service Pipe, and 15 ft. Vertical Rise									
30	0.55	0.96	1.52	3.11	8.57	17.55	47.90	97.17	260.56
40	0.66	1.15	1.81	3.72	10.24	20.95	57.20	116.01	311.09
50	0.75	1.31	2.06	4.24	11.67	23.87	65.18	132.20	354.49
60	0.83	1.45	2.29	4.70	12.94	26.48	72.28	146.61	393.13
75	0.94	1.64	2.59	5.32	14.64	29.96	81.79	165.90	444.58
100	1.10	1.92	3.02	6.21	17.10	35.00	95.55	193.82	519.72
130	1.26	2.20	3.48	7.14	19.66	40.23	109.82	222.75	597.31
Through 100 ft. of Service Pipe, and 30 ft. Vertical Rise									
30	0.44	0.77	1.22	2.50	6.80	14.11	38.63	78.54	211.54
40	0.55	0.97	1.53	3.15	8.68	17.79	48.68	98.98	266.59
50	0.65	1 14	1.79	3.69	10.16	20.82	56.98	115.87	312.08
60	0.73	1.28	2.02	4.15	11.45	23.47	64.22	130.59	351.73
75	0.84	1.47	2.32	4.77	13.15	26.95	73.76	149.99	403.98
100	1.00	1.74	2.75	5.65	15.58	31.93	87.38	177.67	478.55
130	1.15	2.02	3.19	6.55	18.07	37.02	101.33	206.04	554.96

Deliveries will be greater if:

First, If the pipe between meter and the main is of larger diameter than outlet.

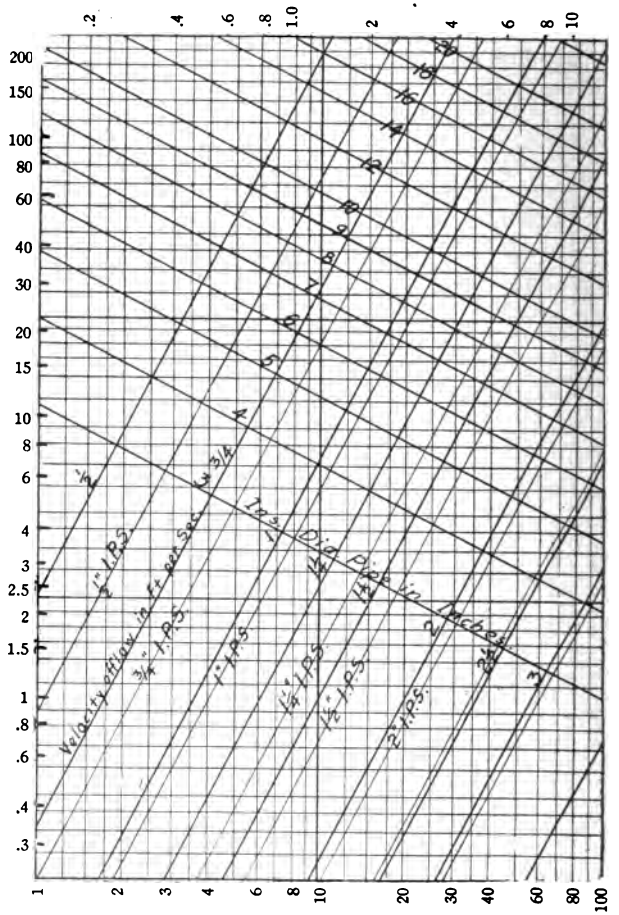
Second, If main is tapped, say for 1-inch pipe, but enlarged from the tap to 1¼ or 1½ inch; or,

Third, If pipe on outlet is larger than that on inlet side of meter.

Quantity of Water Discharged and Friction Loss in

Plotted from Ellis & Howland's Table by Walter R. Clark,

Cubic Foot per Minute Flow



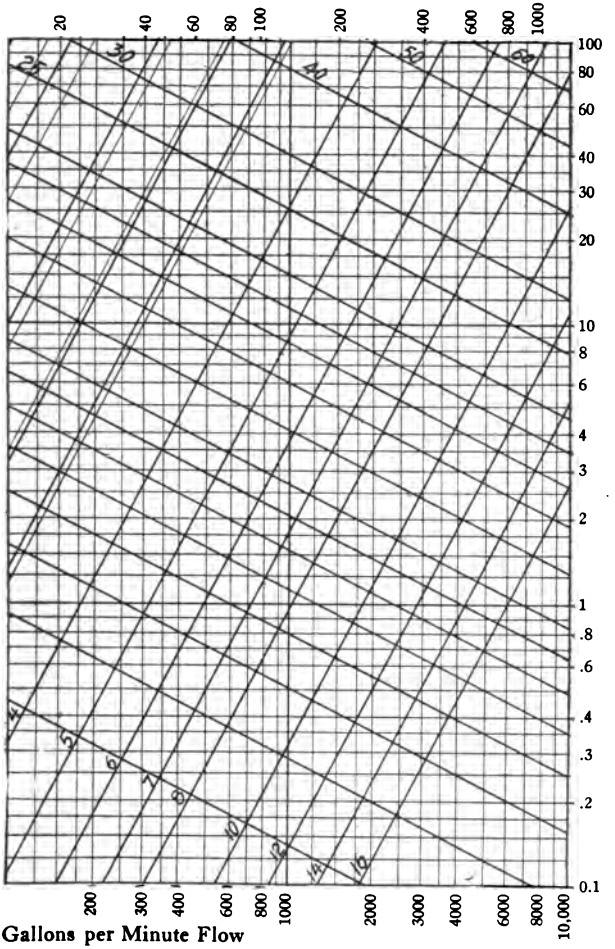
Example I. Given 200 gallons per minute flow for 100 ft. with 10 lbs. pressure loss. Follow vertical line of 200 G.P.M. and horizontal line of 10 lbs. pressure drop to intersection lying between 2½" and 3" pipe diameter and 12 and 13 F.P.S. velocity.

V = Velocity in feet per second
G = Gallons per minute
F = Pounds friction loss per 100 feet

Clean Straight Pipes at Different Velocities of Flow

Ph. B., Designing Engineer with Bridgeport Brass Co.

Cubic Foot per Minute Flow



Gallons per Minute Flow

Example II. Given 4" I.D. pipe and 5 ft. per second velocity. At intersection read down and get 196 G.P.M. and up to get 26 cu. ft. flow read to left and get 2.7 ft. head loss and to right and get 1.17 lbs. pressure drop per 100 ft.

$Q = .245\ V\ D^2$

$F = .03\ Q^2/D^5$ for $V > 3$

D = Diameter in inches

TABLE SHOWING AREAS OF CIRCLES FOR DIAMETERS

Advancing

Fractions of Inch 0 to 31/64	Diameters of Circles in Inches				
	0	1	2	3	4
	....	.7854	3.1416	7.0686	12.566
1/64	.0002	.8101	3.1907	7.1422	12.664
1/32	.0008	.8342	3.2403	7.2163	12.763
3/64	.0017	.8607	3.2903	7.2908	12.862
1/16	.0031	.8866	3.3410	7.3662	12.962
5/64	.0048	.9128	3.3917	7.4414	13.062
3/32	.0069	.9395	3.4428	7.5170	13.162
7/64	.0094	.9664	3.4946	7.5935	13.263
1/8	.0123	.9940	3.5466	7.6699	13.364
9/64	.0155	1.0218	3.5986	7.7467	13.465
/32	.0192	1.0500	3.6515	7.8238	13.567
11/64	.0232	1.0786	3.7045	7.9013	13.669
3/16	.0276	1.1075	3.7583	7.9798	13.772
13/64	.0324	1.1368	3.8120	8.0580	13.875
7/32	.0376	1.1665	3.8662	8.1368	13.978
15/64	.0431	1.1967	3.9211	8.2162	14.082
1/4	.0491	1.2272	3.9761	8.2958	14.186
17/64	.0554	1.2592	4.0314	8.3755	14.290
9/32	.0621	1.2892	4.0871	8.4558	14.395
19/64	.0692	1.3209	4.1431	8.5364	14.500
5/16	.0767	1.3530	4.2000	8.6179	14.607
21/64	.0846	1.3853	4.2569	8.6992	14.712
11/32	.0928	1.4189	4.3141	8.7810	14.819
23/64	.1014	1.4512	4.3721	8.8636	14.926
3/8	.1105	1.4849	4.4301	8.9462	15.033
25/64	.1199	1.5187	4.4884	9.0290	15.140
13/32	.1296	1.5531	4.5472	9.1123	15.248
27/64	.1398	1.5878	4.6064	9.1960	15.356
7/16	.1503	1.6230	4.6664	9.2806	15.466
29/64	.1613	1.6585	4.7263	9.3650	15.574
15/32	.1726	1.6942	4.7866	9.4498	15.684
31/64	.1842	1.7305	4.8477	9.5355	15.794

IN INCHES AND FRACTIONS OF INCHES $\frac{1}{64}$ TO $\frac{11}{64}$ INC.

by $\frac{1}{64}$ths

Fractions of Inch 0 to $\frac{11}{64}$	Diameters of Circles in Inches				
	5	6	7	8	9
	19.635	28.274	38.485	50.265	63.617
1/64	19.757	28.421	38.656	.....	.....
1/32	19.881	28.569	38.828	.....	.....
3/64	20.004	28.717	39.001	.....	.....
1/16	20.129	28.866	39.175	.....	.....
5/64	20.253	29.015	39.348	.....	.....
3/32	20.378	29.164	39.522	.....	.....
7/64	20.503	29.315	39.696	.....	.....
1/8	20.629	29.465	39.871	51.849	65.397
9/64	20.755	29.615	40.046	.....	.....
5/32	20.881	29.766	40.221	.....	.....
11/64	21.007	29.917	40.397	.....	.....
3/16	21.135	30.069	40.547	.....	.....
13/64	21.262	30.221	40.750	.....	.....
7/32	21.390	30.373	40.927	.....	.....
15/64	21.519	30.526	41.105	.....	.....
1/4	21.648	30.680	41.282	53.456	67.201
17/64	21.776	30.833	.....	.....	.....
9/32	21.905	30.986	.....	.....	.....
19/64	22.035	31.140	.....	.....	.....
5/16	22.166	31.296	.....	.....	.....
21/64	22.296	31.451	.....	.....	.....
11/32	22.427	31.606	.....	.....	.....
23/64	22.559	31.763	.....	.....	.....
3/8	22.691	31.919	42.718	55.088	69.029
25/64	22.822	32.075	.....	.....	.....
13/32	22.955	32.232	.....	.....	.....
27/64	23.087	32.389	.....	.....	.....
7/16	23.221	32.548	.....	.....	.....
29/64	23.355	32.706	.....	.....	.....
15/32	23.488	32.864	.....	.....	.....
31/64	23.624	33.024	.....	.....	.....

TABLE SHOWING AREAS OF CIRCLES FOR DIAMETERS

Fractions of Inches 33/64 to 63/64	Diameters of Circles in Inches				
	0	1	2	3	4
1/2	.1964	1.7671	4.9087	9.6211	15.904
33/64	.2087	1.8041	4.9701	9.707	16.015
17/32	.2217	1.8415	5.0320	9.792	16.125
35/64	.2349	1.8793	5.0942	9.880	16.237
9/16	.2485	1.9175	5.1572	9.968	16.349
37/64	.2625	1.9560	5.2202	10.055	16.461
19/32	.2769	1.9949	5.2835	10.143	16.573
39/64	.2917	2.0342	5.3478	10.232	16.687
5/8	.3068	2.0739	5.4119	10.321	16.800
41/64	.3223	2.1140	5.4764	10.409	16.914
21/32	.3382	2.1544	5.5412	10.499	17.027
43/64	.3537	2.1952	5.6066	10.589	17.142
11/16	.3712	2.2365	5.6727	10.680	17.257
45/64	.3883	2.2781	5.7387	10.770	17.372
23/32	.4057	2.3202	5.8051	10.861	17.488
47/64	.4236	2.3625	5.8723	10.953	17.604
3/4	.4418	2.4053	5.9396	11.045	17.728
49/64	.4603	2.4484	6.0071	11.137	17.837
25/32	.4794	2.4919	6.0751	11.229	17.954
51/64	.4988	2.5358	6.1434	11.322	18.071
13/16	.5185	2.5802	6.2126	11.416	18.190
53/64	.5383	2.6248	6.2817	11.509	18.308
27/32	.5591	2.6690	6.3512	11.603	18.426
55/64	.5800	2.7153	6.4214	11.698	18.546
7/8	.6013	2.7612	6.4918	11.793	18.665
57/64	.6229	2.8073	6.5624	11.888	18.785
29/32	.6450	2.8539	6.6335	11.984	18.905
59/64	.6675	2.9008	6.7049	12.080	19.025
15/16	.6903	2.9483	6.7771	12.177	19.147
61/64	.7135	2.9960	6.8493	12.273	19.268
31/32	.7371	3.0441	6.9218	12.370	19.390
63/64	.7667	3.0926	6.9952	12.468	19.512

IN INCHES AND FRACTIONS OF INCHES FROM ½ TO 63/64

Fractions of Inches 33/64 to 63/64	Diameters of Circles in Inches				
	5	6	7	8	9
1/2	23.758	33.183	44.179	56.745	70.882
33/64	23.893	33.343	.....	.....	.....
17/32	24.028	33.502	.....	.....	.....
35/64	24.152	33.663	.....	.....	.....
9/16	24.301	33.824	.....	.....	.....
37/64	24.438	33.985	.....	.....	.....
19/32	24.574	34.147	.....	.....	.....
39/64	24.713	34.309	.....	.....	.....
5/8	24.850	34.472	45.664	58.426	72.760
41/64	24.988	34.634	.....	.....	.....
21/32	25.127	34.797	.....	.....	.....
43/64	25.265	34.960	.....	.....	.....
11/16	25.406	35.125	.....	.....	.....
45/64	25.545	35.289	.....	.....	.....
23/32	25.685	35.454	.....	.....	.....
47/64	25.826	35.619	.....	.....	.....
3/4	25.967	35.785	47.173	60.132	74.662
49/64	26.108	35.950	.....	.....	.....
25/32	26.249	36.116	.....	.....	.....
51/64	26.391	36.283	.....	.....	.....
13/16	26.535	36.450	.....	.....	.....
53/64	26.677	36.618	.....	.....	.....
27/32	26.820	36.785	.....	.....	.....
55/64	26.965	36.954	.....	.....	.....
7/8	27.109	37.122	48.707	61.862	76.589
57/64	27.253	37.291	.....	.....	.....
29/32	27.397	37.460	.....	.....	.....
59/64	27.542	37.629	.....	.....	.....
15/16	27.688	37.800	.....	.....	.....
61/64	27.834	37.971	.....	.....	.....
31/32	27.980	38.141	.....	.....	.....
63/64	28.127	38.313	.....	.....	.....

CAPACITIES OF RECTANGULAR TANKS FIGURED IN U. S. GALLONS, FOR EACH FOOT IN DEPTH

1 Cu. Ft. = 7.4805 U. S. Gallons

Width of Tank		Length of Tank in Feet																			
Ft.	In.	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12
2		37.40	44.88	52.36	59.84	67.32	74.81	82.29	89.77	97.25	104.73	112.21	119.69	127.17	134.65	142.13	149.61	157.09	164.57	172.05	179.53
2	6	46.75	56.10	65.45	74.80	84.16	93.51	102.86	112.21	121.56	130.91	140.26	149.61	158.96	168.31	177.66	187.01	196.36	205.71	215.06	224.41
3		.....	67.32	78.54	89.77	100.99	112.21	123.43	134.65	145.87	157.09	168.31	179.53	190.75	202.97	213.19	224.41	235.63	246.86	258.07	269.30
3	6	.....	.....	91.64	104.73	117.82	130.91	144.00	157.09	170.18	183.27	196.36	209.45	222.54	235.63	248.73	261.82	274.90	288.00	301.09	314.18
4		.....	.....	.....	119.69	134.65	149.61	164.57	179.53	194.49	209.45	224.41	239.37	254.34	269.30	284.26	299.22	314.18	329.14	344.10	359.06
4	6	.....	.....	.....	.....	151.48	168.31	185.14	201.97	218.80	235.63	252.47	269.30	286.13	302.96	319.79	336.62	353.45	370.28	387.11	403.94
5		.....	.....	.....	.....	.....	187.01	205.71	224.41	243.11	261.82	280.52	299.22	317.92	336.62	355.32	374.03	392.72	411.43	430.13	448.83
5	6	.....	.....	.....	.....	.....	.....	226.28	246.86	267.43	288.00	308.57	329.14	349.71	370.28	390.85	411.43	432.00	452.57	473.14	493.71
6		.....	.....	.....	.....	.....	.....	.....	269.30	291.74	314.18	336.62	359.06	381.50	403.94	426.39	448.83	471.27	493.71	516.15	538.59
6	6	.....	.....	.....	.....	.....	.....	.....	.....	316.05	340.36	364.67	388.98	413.30	437.60	461.92	486.23	510.54	534.85	559.16	583.47
7		.....	.....	.....	.....	.....	.....	.....	.....	.....	366.54	392.72	418.91	445.09	471.27	497.45	523.64	549.81	575.99	602.18	628.36
7	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	420.78	448.83	476.88	504.93	532.98	561.04	589.08	617.14	645.19	673.24
8		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	478.75	508.67	538.59	568.51	598.44	628.36	658.28	688.20	718.12
8	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	540.46	572.25	604.06	635.84	667.63	699.42	731.21	763.00
9		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	605.92	639.58	673.25	706.90	740.56	774.23	807.89
9	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	675.11	710.65	746.17	781.71	817.24	852.77
10		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	748.05	785.45	822.86	860.26	897.66
10	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	824.73	864.00	903.26	942.56
11		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	905.14	946.27	987.43
11	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	989.29	103.23
12		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	107.72

TABLE SHOWING POUND *EQUIVALENTS IN* KILOGRAMS

Lbs.	Kilograms.	Lbs.	Kilograms.	Lbs.	Kilograms.	Lbs.	Kilograms.
1	.4535	26	11 .7910	51	23 .1285	76	34 .4660
2	.9070	27	12 .2445	52	23 .5820	77	34 .9195
3	1 .3605	28	12 .6980	53	24 .0355	78	35 .3730
4	1 .8140	29	13 .1515	54	24 .4890	79	35 .8265
5	2 .2675	30	13 .6050	55	24 .9425	80	36 .28
6	2 .7210	31	14 .0585	56	25 .3960	81	36 .7335
7	3 .1745	32	14 .5120	57	25 .8495	82	37 .1870
8	3 .6280	33	14 .9655	58	26 .3030	83	37 .6405
9	4 .0815	34	15 .4190	59	26 .7565	84	38 .0940
10	4 .5350	35	15 .8725	60	27 .21	85	38 .5475
11	4 .9885	36	16 .3260	61	27 .6635	86	39 .0010
12	5 .4420	37	16 .7795	62	28 .1170	87	39 .4545
13	5 .8955	38	17 .2330	63	28 .5705	88	39 .9080
14	6 .3490	39	17 .6865	64	29 .0240	89	40 .3615
15	6 .8025	40	18 .14	65	29 .4775	90	40 .8150
16	7 .2560	41	18 .5935	66	29 .9310	91	41 .2685
17	7 .7095	42	19 .0470	67	30 .3845	92	41 .7220
18	8 .1630	43	19 .5005	68	30 .8380	93	42 .1755
19	8 .6165	44	19 .9540	69	31 .2915	94	42 .6290
20	9 .07	45	20 .4075	70	31 .7450	95	43 .0825
21	9 .5235	46	20 .8610	71	32 .1985	96	43 .5360
22	9 .9770	47	21 .3145	72	32 .6520	97	43 .9895
23	10 .4305	48	21 .7680	73	33 .1055	98	44 .4430
24	10 .8840	49	22 .2215	74	33 .5590	99	44 .8965
25	11 .3375	50	22 .6750	75	34 .0125	100	45 .35

Metric and English Measures:

To convert millimeters into inches, multiply by .03937.

To convert meters* into inches (or millimeters into mils), multiply by 39.37.

To convert meters into feet, multiply by 3.81.

To convert meters into yards, multiply by 1.094.

To convert kilometers into statute miles, multiply by .6214.

To convert kilometers into nautical miles, multiply by .539.

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* For the purpose of memory, a meter may be considered as three feet three inches and a third.

TABLE SHOWING AREAS OF CIRCLES FOR DIAMETERS IN INCHES AND DECIMALS OF INCHES, 0.1 TO 10.0 INCHES

Advancing by 0.1

Diameter	Area	Circumference	Diameter	Area	Circumference
0.1	.007854	.31416	4.0	12.5664	12.5664
.2	.031416	.62832	.1	13.2025	12.8805
.3	.070686	.94248	.2	13.8544	13.1947
.4	.12566	1.2566	.3	14.5220	13.5088
.5	.19635	1.5708	.4	15.2053	13.8230
.6	.28274	1.8850	.5	15.9043	14.1372
.7	.38485	2.1991	.6	16.6190	14.4513
.8	.50266	2.5133	.7	17.3494	14.7655
.9	.63617	2.8274	.8	18.0956	15.0796
1.0	.7854	3.1416	.9	18.8574	15.3938
.1	.9503	3.4558	5.0	19.6350	15.7080
.2	1.1310	3.7699	.1	20.4282	16.0221
.3	1.3273	4.0841	.2	21.2372	16.3363
.4	1.5394	4.3982	.3	22.0618	16.6504
.5	1.7671	4.7128	.4	22.9022	16.9646
.6	2.0106	5.0265	.5	23.7583	17.2788
.7	2.2698	5.3407	.6	24.6301	17.5929
.8	2.5447	5.6549	.7	25.5176	17.9071
.9	2.8353	5.9690	.8	26.4208	18.2212
2.0	3.1416	6.2832	.9	27.3397	18.5354
.1	3.4636	6.5973	6.0	28.2743	18.8496
.2	3.8013	6.9115	.1	29.2247	19.1637
.3	4.1548	7.2257	.2	30.1907	19.4779
.4	4.5239	7.5398	.3	31.1725	19.7920
.5	4.9087	7.8540	.4	32.1699	20.1062
.6	5.3093	8.1681	.5	33.1831	20.4204
.7	5.7256	8.4823	.6	34.2119	20.7345
.8	6.1575	8.7965	.7	35.2565	21.0487
.9	6.6052	9.1106	.8	36.3168	21.3628
3.0	7.0686	9.4248	.9	37.3928	21.6770
.1	7.5477	9.7398	7.0	38.4845	21.9911
.2	8.0425	10.0531	.1	39.5919	22.3053
.3	8.5530	10.3673	.2	40.7150	22.6195
.4	9.0792	10.6814	.3	41.8539	22.9336
.5	9.6211	10.9956	.4	43.0084	23.2478
.6	10.1788	11.3097	.5	44.1786	23.5619
.7	10.7521	11.6239	.6	45.3646	23.8761
.8	11.3411	11.9381	.7	46.5663	24.1903
.9	11.9459	12.2522	.8	47.7836	24.5044
			.9	49.0167	24.8186

TABLE SHOWING AREAS OF CIRCLES FOR DIAMETERS IN INCHES AND DECIMALS OF INCHES, 0.1 TO 10.0 INCHES—(Continued.)

Advancing by 0.1

Diameter	Area	Circumference	Diameter	Area	Circumference
8.0	50.2655	25.1327	9.0	63.6173	28.2743
.1	51.5300	25.4469	.1	65.0388	28.5885
.2	52.8102	25.7611	.2	66.4761	28.9027
.3	54.1061	26.0752	.3	67.9291	29.2168
.4	55.4177	26.3894	.4	69.3978	29.5310
.5	56.7450	26.7035	.5	70.8822	29.8451
.6	58.0880	27.0177	.6	72.3823	30.1593
.7	59.4468	27.3319	.7	73.8981	30.4734
.8	60.8212	27.6460	.8	75.4296	30.7876
.9	62.2114	27.9602	.9	76.9769	31.1018

AREAS, ETC., OF REGULAR POLYGONS

No. of sides.	Name	Area when diameter of inscribed circle = 1	Area when side = 1	Length of side when perpendicular = 1	Perpendicular when side = 1	Radius of circumscrd. circle when side = 1	Lgth. of side when radius of circumsd. circle. = 1
3	Triangle...	1.299	0.433	3.464	0.289	.577	1.732
4	Square....	1.000	1.000	2.000	0.500	.707	1.414
5	Pentag....	.908	1.720	1.453	0.688	.851	1.176
6	Hexag.....	.866	2.598	1.155	0.866	1.000	1.000
7	Heptag....	.843	3.634	.963	1.039	1.152	.868
8	Octag.....	.828	4.828	.828	1.207	1.307	.765
9	Nonag.....	.819	6.182	.728	1.374	1.462	.684
10	Decag.....	.812	7.694	.650	1.539	1.618	.618
11	Undecag...	.807	9.366	.587	1.703	1.775	.563
12	Dodecag...	.804	11.196	.536	1.866	1.932	.518

Area of any regular polygon = Radius of inscribed circle × number of sides × length of one side ÷ 2.

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circum-ference.	Area Sq. Inches.	Diam. Inches	Circum-ference	Area Sq. Inches.
1	3.1416	0.7854	66	207.34	3421.19
2	6.2832	3.1416	67	210.49	3525.65
3	9.4248	7.0686	68	213.63	3631.68
4	12.5664	12.5664	69	216.77	3739.28
5	15.7080	19.635	70	219.91	3848.45
6	18.850	28.274	71	223.05	3959.19
7	21.991	38.485	72	226.19	4071.50
8	25.133	50.266	73	229 34	4185.39
9	28.274	63.617	74	232.48	4300.84
10	31.416	78.540	75	235.62	4417.86
11	34.558	95.033	76	238.76	4536.46
12	37.699	113.10	77	241.90	4656.63
13	40.841	132.73	78	245.04	4778.36
14	43.982	153.94	79	248.19	4901.67
15	47.124	176.71	80	251.33	5026.55
16	50.265	201.06	81	254.47	5153.00
17	53.407	226.98	82	257.61	5281.02
18	56.549	254.47	83	260.75	5410.61
19	59.690	283.53	84	263.89	5541.77
20	62.832	314.16	85	267.04	5674.50
21	65.973	346.36	86	270.18	5808.80
22	69.115	380.13	87	273.32	5944.68
23	72.257	415.48	88	276.46	6082.12
24	75.398	452.39	89	279.60	6221.14
25	78.540	490.87	90	282.74	6361.73
26	81.681	530.93	91	285.88	6503.88
27	84.823	572.56	92	289.03	6647.61
28	87.965	615.75	93	292.17	6792.91
29	91.106	660.52	94	295.31	6939.78
30	94.248	706.86	95	298.45	7088.22
31	97.389	754.77	96	301.59	7238.23
32	100.53	804.25	97	304.73	7389.81
33	103.67	855.30	98	307.88	7542.96
34	106.81	907.92	99	311.02	7697.69
35	109.96	962.11	100	314.16	7853.98
36	113.10	1017.88	101	317.30	8011.85
37	116.24	1075.21	102	320.44	8171.28
38	119.38	1134.11	103	323.58	8332.29
39	122.52	1194.59	104	326.73	8494.87
40	125.66	1256.64	105	329.87	8659.01
41	128.81	1320.25	106	333.01	8824.73
42	131.95	1385.44	107	336.15	8992.02
43	135.09	1452.20	108	339.29	9160.88
44	138.23	1520.53	109	342.43	9331.32
45	141.37	1590.43	110	345.58	9503.32
46	144.51	1661.90	111	348.72	9676.89
47	147.65	1734.94	112	351.86	9852.03
48	150.80	1809.56	113	355.00	10028.75
49	153.94	1885.74	114	358.14	10207.03
50	157.08	1963.50	115	361.28	10386.89
51	160.22	2042.82	116	364.42	10568.32
52	163.36	2123.72	117	367.57	10751.32
53	166.50	2206.18	118	370.71	10935.88
54	169.65	2290.22	119	373.85	11122.02
55	172.79	2375.83	120	376.99	11309.73
56	175.93	2463.01	121	380.13	11499.01
57	179.07	2551.76	122	383.27	11689.87
58	182.21	2642.08	123	386.42	11882.29
59	185.35	2733.97	124	389.56	12076.28
60	188.50	2827.43	125	392.70	12271.85
61	191.64	2922.47	126	395.84	12468.98
62	194.78	3019.07	127	398.98	12667.69
63	197.92	3117.25	128	402.12	12867.96
64	201.06	3216.99	129	405.27	13069.81
65	204.20	3318.31	130	408.41	13273.23

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circum-ference.	Area Sq. Inches.	Diam. Inches	Circum-ference.	Area Sq. Inches.
131	411.55	13478.22	196	615.75	30171.86
132	414.69	13684.78	197	618.89	30480.52
133	417.83	13892.91	198	622.04	30790.75
134	420.97	14102.61	199	625.18	31102.55
135	424.12	14313.88	**200**	628.32	31415.93
136	427.26	14526.72	201	631.46	31730.87
137	430 40	14741.14	202	634.60	32047.39
138	433.54	14957.12	203	637.74	32365.47
139	436.68	15174.68	204	640.88	32685.13
140	439.82	15393.80	205	644.03	33006.36
141	442.96	15614.50	206	647.17	33329.16
142	446.11	15836.77	207	650.31	33653 53
143	449.25	16060.61	208	653.45	33979.47
144	452.39	16286.02	209	656.59	34306.98
145	455.53	16513.00	**210**	659.73	34636.06
146	458.67	16741.55	211	662.88	34966.71
147	461.81	16971.67	212	666.02	35298.94
148	464.96	17203.36	213	669.16	35632.73
149	468.10	17436.62	214	672.30	35968.09
150	471.24	17671.46	215	675.44	36305.03
151	474.38	17907.86	216	678.58	36643.54
152	477.52	18145.84	217	681.73	36983.61
153	480.66	18385.39	218	684.87	37325.26
154	483.81	18626.50	219	688.01	37668.48
155	486.95	18869.19	**220**	691.15	38013.27
156	490.09	19113.45	**221**	694.29	38359.63
157	493.23	19359.28	**222**	697.43	38707.56
158	496.37	19606.68	223	700.58	39057.07
159	499.51	19855.65	224	703.72	39408.14
160	502.65	20106.19	225	706.86	39760.78
161	505.80	20358.31	226	710.00	40115.00
162	508.94	20611.99	227	713.14	40470.78
163	512.08	20867.24	228	716.28	40828.14
164	515.22	21124.07	229	719.42	41187.07
165	518.36	21382.46	**230**	722.57	41547.56
166	521.50	21642.43	231	725.71	41909.63
167	524.65	21903.97	232	728.85	42273.27
168	527.79	22167.08	233	731.99	42638.48
169	530.93	22431.76	234	735.13	43005.26
170	534.07	22698.01	235	738.27	43373.61
171	537.21	22965.83	236	741.42	43743.54
172	540.35	23235.22	237	744.56	44115.03
173	543.50	23506.18	238	747.70	44488.09
174	546.64	23778.71	239	750.84	44862.73
175	549.78	24052.82	**240**	753.98	45238.93
176	552.92	24328.49	241	757.12	45616.71
177	556.06	24605.74	242	760.27	45996.06
178	559.20	24884.56	243	763.41	46376.98
179	562.35	25164.94	244	766.55	46759.47
180	565.49	25446.90	245	769.69	47143.52
181	568.63	25730.43	246	772.83	47529.16
182	571.77	26015.53	247	775.97	47916.36
183	574.91	26302.20	248	779.11	48305.13
184	578.05	26590.44	249	782.26	48695.47
185	581.19	26880.25	**250**	785.40	49087.39
186	584.34	27171.63	251	788.54	49480.87
187	587.48	27464.59	252	791.68	49875.92
188	590.62	27759.11	253	794.82	50272.55
189	593.76	28055.21	254	797.96	50670.75
190	596.90	28352.87	255	801.11	51070.52
191	600.04	28652.11	256	804.25	51471.85
192	603.19	28952.92	257	807.39	51874.76
193	606.33	29255.30	258	810.53	52279.24
194	609.47	29559.25	259	813.67	52685.29
195	612.61	29864.77	**260**	816.81	53092.92

CIRCUMFERENCES AND AREAS OF CIRCLE

Diam. Inches.	Circum-ference.	Area Sq. Inches.	Diam. Inches	Circum-ference	Area Sq. Inches.
261	819.96	53502.11	326	1024.16	83468.98
262	823.10	53912.87	327	1027.30	83981.84
263	826.24	54325.21	328	1030.44	84496.28
264	829.38	54739.11	329	1033.58	85012.28
265	832.52	55154.59	**330**	1036.73	85529.86
266	835.66	55571.63	331	1039.87	86049.01
267	838.81	55990.25	332	1043.01	86569.73
268	841.95	56410.44	333	1046.15	87092.02
269	845.09	56832.20	334	1049.29	87615.88
270	848.23	57255.53	335	1052.43	88141.31
271	851.37	57680.43	336	1055.58	88668.31
272	854.51	58106.90	337	1058.72	89196.88
273	857.65	58534.94	338	1061.86	89727.03
274	860.80	58964.55	339	1065.00	90258.74
275	863.94	59395.74	**340**	1068.14	90792.03
276	867.08	59828.49	341	1071.28	91326.88
277	870.22	60262.82	342	1074.42	91863.31
278	873.36	60698.71	343	1077.57	92401.31
279	876.50	61136.18	344	1080.71	92940.88
280	879.65	61575.22	345	1083.85	93482.02
281	882 79	62015.82	346	1086.99	94024.73
282	885.93	62458.00	347	1090.13	94569.01
283	889.07	62901.75	348	1093.27	95114.86
284	892.21	63347.07	349	1096.42	95662.28
285	895.35	63793.97	**350**	1099.56	96211.28
286	898.50	64242.43	351	1102.70	96761.84
287	901.64	64692.46	352	1105.84	97313.97
288	904.78	65144.07	353	1108.98	97867.68
289	907.92	65597.24	354	1112.12	98422.96
290	911.06	66051.99	355	1115.27	98979.80
291	914.20	66508.30	356	1118.41	99538.22
292	917.35	66966.19	357	1121.55	100098.21
293	920.49	67425.65	358	1124.69	100659.77
294	923.63	67886.68	359	1127.83	101222.90
295	926.77	68349.28	**360**	1130.97	101787.60
296	929.91	68813.45	361	1134.11	102353.87
297	933.05	69279.19	362	1137.26	102921.72
298	936.19	69746.50	363	1140.40	103491.13
299	939.34	70215.38	364	1143.54	104062.12
300	942.48	70685.83	365	1146.68	104634.67
301	945.62	71157.86	366	1149.82	105208.80
302	948.76	71631.45	367	1152.96	105784.49
303	951.90	72106.62	368	1156.11	106361.76
304	955.04	72583.36	369	1159.25	106940.60
305	958.19	73061.66	**370**	1162.39	107521.01
306	961.33	73541.54	371	1165.53	108102.99
307	964.47	74022.99	372	1168.67	108686.54
308	967.61	74506.01	373	1171.81	109271.66
309	970.75	74990.60	374	1174.96	109858.35
310	973.89	75476.76	375	1178.10	110446.62
311	977.04	75964.50	376	1181.24	111036.45
312	980.18	76453.80	377	1184.38	111627.86
313	983.32	76944.67	378	1187.52	112220.83
314	986.46	77437.12	379	1190.66	112815.38
315	989.60	77931.13	**380**	1193.81	113411.49
316	992.74	78426.72	381	1196.95	114009.18
317	995.88	78923.88	382	1200.09	114608.44
318	999.03	79422.60	383	1203.23	115209.27
319	1002.17	79922.90	384	1206.37	115811.67
320	1005.31	80424.77	385	1209.51	116415.64
321	1008.45	80928.21	386	1212.65	117021.18
322	1011.59	81433.22	387	1215.80	117628.30
323	1014.73	81939.80	388	1218.94	118236.98
324	1017.88	82447.96	389	1222.08	118847.24
325	1021.02	82957.68	**390**	1225.22	119459.06

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circum-ference.	Area Sq. Inches.	Diam. Inches.	Circum-ference.	Area Sq. Inches.
391	1228.36	120072.46	456	1432.57	163312.55
392	1231.50	120687.42	457	1435.71	164029.62
393	1234.65	121303.96	458	1438.85	164748.26
394	1237.79	121922.07	459	1441.99	165468.47
395	1240.93	122541.75	460	1445.13	166190.25
396	1244.07	123163.00	461	1448.27	166913.60
397	1247.21	123785.82	462	1451.42	167638.53
398	1250.35	124410.21	463	1454.56	168365.02
399	1253.50	125036.17	464	1457.70	169093.08
400	1256.64	125663.71	465	1460.84	169822.72
401	1259.78	126292.81	466	1463.98	170553.92
402	1262.92	126923.48	467	1467.12	171286.70
403	1266.06	127555.73	468	1470.27	172021.05
404	1269.20	128189.55	469	1473.41	172756.97
405	1272.35	128824.93	470	1476.55	173494.45
406	1275.49	129461.89	471	4179.69	174233.51
407	1278.63	130100.42	472	1482.83	174974.14
408	1281.77	130740.52	473	1485.97	175716.35
409	1284.91	131382.19	474	1489.11	176460.12
410	1288.05	132025.43	475	1492.26	177205.46
411	1291.19	132670.24	476	1495.40	177952.37
412	1294.34	133316.63	477	1498.54	178700.86
413	1297.48	133964.58	478	1501.68	179450.91
414	1300.62	134614.10	479	1504.82	180202.54
415	1303.76	135265.20	480	1507.96	180955.74
416	1306.90	135917.86	481	1511.11	181710.50
417	1310.04	136572.10	482	1514.25	182466.84
418	1313.19	137227.91	483	1517.39	183224.75
419	1316.33	137885.29	484	1520.53	183984.23
420	1319.47	138544.24	485	1523.67	184745.28
421	1322.61	139204.76	486	1526.81	185507.90
422	1325.75	139866.85	487	1529.96	186272.10
423	1328.89	140530.51	488	1533.10	187037.86
424	1332.04	141195.74	489	1536.24	187805.19
425	1335.18	141862.54	490	1539.38	188574.10
426	1338.32	142530.92	491	1542.52	189344.57
427	1341.46	143200.86	492	1545.66	190116.62
428	1344.60	143872.38	493	1548.81	190890.24
429	1347.74	144545.46	494	1551.95	191665 43
430	1350.88	145220.12	495	1555.09	192442.18
431	1354.03	145896.35	496	1558.23	193220.51
432	1357.17	146574.15	497	1561.37	194000.41
433	1360.31	147253.52	498	1564.51	194781.89
434	1363.45	147934.46	499	1567.65	195564.93
435	1366.59	148616.97	500	1570.80	196349.54
436	1369.73	149301.05	501	1573.94	197135.72
437	1372.88	149986.70	502	1577.08	197923.48
438	1376.02	150673.93	503	1580.22	198712.80
439	1379.16	151362.72	504	1583.36	199503.70
440	1382.30	152053.08	505	1586.50	200296.17
441	1385.44	152745.02	506	1589.65	201090.20
442	1388.58	153438.53	507	1592.79	201885.81
443	1391.73	154133.60	508	1595.93	202682.99
444	1394.87	154830.25	509	1599.07	203481.74
445	1398.01	155528.47	510	1602.21	204282.06
446	1401.15	156228.26	511	1605.35	205083.95
447	1404.29	156929.62	512	1608.50	205887.42
448	1407.43	157632.55	513	1611.64	206692.45
449	1410.58	158337.06	514	1614.78	207499.05
450	1413.72	159043.13	515	1617.92	208307.23
451	1416.86	159750.77	516	1621.06	209116.97
452	1420.00	160459.99	517	1624.20	209928.29
453	1423.14	161170.77	518	1627.34	210741.18
454	1426.28	161883.13	519	1630.49	211555.63
455	1429.42	162597.05	520	1633.63	212371.66

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circum-ference.	Area Sq. Inches.	Diam. Inches.	Circum-ference.	Area Sq. Inches.
521	1636.77	213189.26	586	1840.97	269702.59
522	1639.91	214008.43	587	1844.11	270623.86
523	1643.05	214829.17	588	1847.26	271546.70
524	1646.19	215651.49	589	1850.40	272471.12
525	1649.34	216475.37	**590**	1853.54	273397.10
526	1652.48	217300.82	591	1856.68	274324.66
527	1655.62	218127.85	592	1859.82	275253.78
528	1658.76	218956.44	593	1862.96	276184.48
529	1661.90	219786.61	594	1866.11	277116.75
530	1665.04	220618.34	595	1869.25	278050.58
531	1668.19	221451.65	596	1872.39	278985.99
532	1671.33	222286.53	597	1875.53	279922.97
533	1674.47	223122.98	598	1878.67	280861.52
534	1677.61	223961.00	599	1881.81	281801.65
535	1680.75	224800.59	**600**	1884.96	282743.34
536	1683.89	225641.75	601	1888.10	283686.60
537	1687.04	226484.48	602	1891.24	284631.44
538	1690.18	227328.79	603	1894.38	285577.84
539	1693.32	228174.66	604	1897.52	286525.82
540	1696.46	229022.10	605	1900.66	287475.36
541	1699.60	229871.12	606	1903.81	288426.48
542	1702.74	230721.71	607	1906.95	289379.17
543	1705.88	231573.86	608	1910.09	290333.43
544	1709.03	232427.59	609	1913.23	291289.26
545	1712.17	233282.89	**610**	1916.37	292246.66
546	1715.31	234139.76	611	1919.51	293205.63
547	1718.45	234998.20	612	1922.65	294166.17
548	1721.59	235858.21	613	1925.80	295128.28
549	1724.73	236719.79	614	1928.94	296091.97
550	1727.88	237582.94	615	1932.08	297057.22
551	1731.02	238447.67	616	1935.22	298024.05
552	1734.16	239313.96	617	1938.36	298992.44
553	1737.30	240181.83	618	1941.50	299962.41
554	1740.44	241051.26	619	1944.65	300933.95
555	1743.58	241922.27	**620**	1947.79	301907.05
556	1746.73	242794.85	621	1950.93	302881.73
557	1749.87	243668.99	622	1954.07	303857.98
558	1753.01	244544.71	623	1957.21	304835.80
559	1756.15	245422.00	624	1960.35	305815.20
560	1759.29	246300.86	625	1963.50	306796.16
561	1762.43	247181.30	626	1966.64	307778.69
562	1765.58	248063.30	627	1969.78	308762.79
563	1768.72	248946.87	628	1972.92	309748.47
564	1771.86	249832.01	629	1976.06	310735.71
565	1775.00	250718.73	**630**	1979.20	311724.53
566	1778.14	251607.01	631	1982.35	312714.92
567	1781.28	252496.87	632	1985.49	313706.88
568	1784.42	253388.30	633	1988.63	314700.40
569	1787.57	254281.29	634	1991.77	315695.50
570	1790.71	255175.86	635	1994.91	316692.17
571	1793.85	256072.00	636	1998.05	317690.42
572	1796.99	256969.71	637	2001.19	318690.23
573	1800.13	257868.99	638	2004.34	319691.61
574	1803.27	258769.85	639	2007.48	320694.56
575	1806.42	259672.27	**640**	2010.62	321699.09
576	1809.56	260576.26	641	2013.76	322705.18
577	1812.70	261481.83	642	2016.90	323712.85
578	1815.84	262388.96	643	2020.04	324722.09
579	1818.98	263297.67	644	2023.19	325732.89
580	1822.12	264207.94	645	2026.33	326745.27
581	1825.27	265119.79	646	2029.47	327759.22
582	1828.41	266033.21	647	2032.61	328774.74
583	1831.55	266948.20	648	2035.75	329791.83
584	1834.69	267864.76	649	2038.89	330810.49
585	1837.83	268782.89	**650**	2042.04	331830.72

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circumference.	Area Sq. Inches.	Diam. Inches.	Circumference	Area Sq. Inches.
651	2045.18	332852.53	716	2249.38	402639.08
652	2048.32	333875.90	717	2252.52	403764.56
653	2051.46	334900.85	718	2255.66	404891.60
654	2054.60	335927.36	719	2258.81	406020.22
655	2057.74	336955.45	**720**	2261.95	407150.41
656	2060.88	337985.10	721	2265.09	408282.17
657	2064.03	339016.33	722	2268.23	409415.50
658	2067.17	340049.13	723	2271.37	410550.40
659	2070.31	341083.50	724	2274.51	411686.87
660	2073.45	342119.44	725	2277.65	412824.91
661	2076.59	343156.95	726	2280.80	413964.52
662	2079.73	344196.03	727	2283.94	415105.71
663	2082.88	345236.69	728	2287.08	416248.46
664	2086.02	346278.91	729	2290.22	417392.79
665	2089.16	347322.70	**730**	2293.36	418538.68
666	2092.30	348368.07	731	2296.50	419686.15
667	2095.44	349415.00	732	2299.65	420835.19
668	2098.58	350463.51	733	2302.79	421985.79
669	2101.73	351513.59	734	2305.93	423137.97
670	2104.87	352565.24	735	2309.07	424291.72
671	2108.01	353618.45	736	2312.21	425447.04
672	2111.15	354673.24	737	2315.35	426603.94
673	2114.29	355729.60	738	2318.50	427762.40
674	2117.43	356787.54	739	2321.64	428922.43
675	2120.58	357847.04	**740**	2324.78	430084.03
676	2123.72	358908.11	741	2327.92	431247.21
677	2126.86	359970.75	742	2331.06	432411.95
678	2130.00	361034.97	743	2334.20	433578.27
679	2133.14	362100.75	744	2337.34	434746.16
680	2136.28	363168.11	745	2340.49	435915.62
681	2139.42	364237.04	746	2343.63	437086.64
682	2142.57	365307.54	747	2346.77	438259.24
683	2145.71	366379.60	748	2349.91	439433.41
684	2148.85	367453.24	749	2353.05	440609.16
685	2151.99	368528.45	**750**	2356.19	441786.47
686	2155.13	369605.23	751	2359.34	442965.35
687	2158.27	370683.59	752	2362.48	444145.80
688	2161.42	371763.51	753	2365.62	445327.83
689	2164.56	372845.00	754	2368.76	446511.42
690	2167.70	373928.07	755	2371.90	447696.59
691	2170.84	375012.70	756	2375.04	448883.32
692	2173.98	376098.91	757	2378.19	450071.63
693	2177.12	377186.68	758	2381.33	451261.51
694	2180.27	378276.03	759	2384.47	452452.96
695	2183.41	379366.95	**760**	2387.61	453645.98
696	2186.55	380459.44	761	2390.75	454840.57
697	2189.69	381553.50	762	2393.89	456036.73
698	2192.83	382649.13	763	2397.04	457234.46
699	2195.97	383746.33	764	2400.18	458433.77
700	2199.11	384845.10	765	2403.32	459634.64
701	2202.26	385945.44	766	2406.46	460837.08
702	2205.40	387047.36	767	2409.60	462041.10
703	2208.54	388150.84	768	2412.74	463246.69
704	2211.68	389255.90	769	2415.88	464453.84
705	2214.82	390362.52	**770**	2419.03	465662.57
706	2217.96	391470.72	771	2422.17	466872.87
707	2221.11	392580.49	772	2425.31	468084.74
708	2224.25	393691.82	773	2428.45	469298.18
709	2227.39	394804.73	774	2431.59	470513.19
710	2230.53	395919.21	775	2434.73	471729.77
711	2233.67	397035.26	776	2437.88	472947.92
712	2236.81	398152.89	777	2441.02	474167.65
713	2239.96	399272.08	778	2444.16	475388.94
714	2243.10	400392.84	779	2447.30	476611.81
715	2246.24	401515.18	**780**	2450.44	477836.24

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circum-ference.	Area Sq. Inches.	Diam. Inches.	Circum-ference.	Area Sq. Inches.
781	2453.58	479062.25	846	2657.79	562122.03
782	2456.73	480289.83	847	2660.93	563451.71
783	2459.87	481518.97	848	2664.07	564782.96
784	2463.01	482749.69	849	2667.21	566115.78
785	2466.15	483981.98	**850**	2670.35	567450.17
786	2469.29	485215.84	851	2673.50	568786.14
787	2472.43	486451.28	852	2676.64	570123.67
788	2475.58	487688.28	853	2679.78	571462.77
789	2478.72	488926.85	854	2682.92	572803.45
790	2481.86	490166.99	855	2686.06	574145.69
791	2485.00	491408.71	856	2689.20	575489.51
792	2488.14	492651.99	857	2692.34	576834.90
793	2491.28	493896.85	858	2695.49	578181.85
794	2494.42	495143.28	859	2698.63	579530.38
795	2497.57	496391.27	**860**	2701.77	580880.48
796	2500.71	497640.84	861	2704.91	582232.15
797	2503.85	498891.98	862	2708.05	583585.39
798	2506.99	500144.69	863	2711.19	584940.20
799	2510.13	501398.97	864	2714.34	586296.59
800	2513.27	502654.82	865	2717.48	587654.54
801	2516.42	503912.25	866	2720.62	589014.07
802	2519.56	505171.24	867	2723.76	590375.16
803	2522.70	506431.80	868	2726.90	591737.83
804	2525.84	507693.94	869	2730.04	593102.06
805	2528.98	508957.64	**870**	2733.19	594467.87
806	2532.12	510222.92	871	2736.33	595835.25
807	2535.27	511489.77	872	2739.47	597204.20
808	2538.41	512758.19	873	2742.61	598574.72
809	2541.55	514028.18	874	2745.75	599946.81
810	2544.69	515299.74	875	2748.89	601320.47
811	2547.83	516572.87	876	2752.04	602695.70
812	2550.97	517847.57	877	2755.18	604072.50
813	2554.11	519123.84	878	2758.32	605450.88
814	2557.26	520401.68	879	2761.46	606830.82
815	2560.40	521681.10	**880**	2764.60	608212.34
816	2563.54	522962.08	881	2767.74	609595.42
817	2566.68	524244.63	882	2770.88	610980.08
818	2569.82	525528.76	883	2774.03	612366.31
819	2572.96	526814.46	884	2777.17	613754.11
820	2576.11	528101.73	885	2780.31	615143.48
821	2579.25	529390.56	886	2783.45	616534.42
822	2582.39	530680.97	887	2786.59	617926.93
823	2585.53	531972.95	888	2789.73	619321.01
824	2588.67	533266.50	889	2792.88	620716.66
825	2591.81	534561.62	**890**	2796.02	622113.89
826	2594.96	535858.32	891	2799.16	623512.68
827	2598.10	537156.58	892	2802.30	624913.04
828	2601.24	538456.41	893	2805.44	626314.98
829	2604.38	539757.82	894	2808.58	627718.49
830	2607.52	541060.79	895	2811.73	629123.56
831	2610.66	542365.34	896	2814.87	630530.21
832	2613.81	543671.46	897	2818.01	631938.43
833	2616.95	544979.15	898	2821.15	633348.22
834	2620.09	546288.40	899	2824.29	634759.58
835	2623.23	547599.23	**900**	2827.43	636172.51
836	2626.37	548911.63	901	2830.58	637587.01
837	2629.51	550225.61	902	2833.72	639003.09
838	2632.65	551541.15	903	2836.86	640420.73
839	2635.80	552858.26	904	2840.00	641839.95
840	2638.94	554176.94	905	2843.14	643260.73
841	2642.08	555497.20	906	2846.28	644683.09
842	2645.22	556819.02	907	2849.42	646107.01
843	2648.36	558142.42	908	2852.57	647532.51
844	2651.50	559467.39	909	2855.71	648959.58
845	2654.65	560793.92	**910**	2858.85	650388.22

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches.	Circum-ference.	Area. Sq. Inches.	Diam. Inches.	Circum-ference.	Area. Sq. Inches.
911	2861.99	651818.43	976	3066.19	748151.44
912	2865.13	653250.21	977	3069.34	749685.32
913	2868.27	654683.56	978	3072.48	751220.78
914	2871.42	656118.48	979	3075.62	752757.80
915	2874.56	657554.98	**980**	3078.76	754296.40
916	2877.70	658993.04	981	3081.90	755836.56
917	2880.84	660432.68	982	3085.04	757378.30
918	2883.98	661873.88	983	3088.19	758921.61
919	2887.12	663316.66	984	3091.33	760466.48
920	2890.27	664761.01	985	3094.47	762012.93
921	2893.41	666206.92	986	3097.61	763560.95
922	2896.55	667654.41	987	3100.75	765110.54
923	2899.69	669103.47	988	3103.89	766661.70
924	2902.83	670554.10	989	3107.04	768214.44
925	2905.97	672006.30	**990**	3110.18	769768.74
926	2909.11	673460.08	991	3113.32	771324.61
927	2912.26	674915.42	992	3116.46	772882.06
928	2915.40	676372.33	993	3119.60	774441.07
929	2918.54	677830.82	994	3122.74	776001.66
930	2921.68	679290.87	995	3125.88	777563.82
931	2924.82	680752.50	996	3129.03	779127.54
932	2927.96	682215.69	997	3132.17	780692.84
933	2931.11	683680.46	998	3135.31	782259.71
934	2934.25	685146.80	999	3138.45	783828.15
935	2937.39	686614.71	**1.000**	3141.59	785398.16
936	2940.53	688084.19	**1.001**	3.1447	.787(
937	2943.67	689555.24	2	3.1479	.788!
938	2946.81	691027.86	3	3.1510	.790:
939	2949.96	692502.05	4	3.1542	.791:
940	2953.10	693977.82	5	3.1573	.793:
941	2956.24	695455.15	6	3.1604	.794!
942	2959.38	696934.06	7	3.1636	.796(
943	2962.52	698414.53	8	3.1668	.798(
944	2965.66	699896.58	9	3.1700	.799(
945	2968.81	701380.19	**1.010**	3.1731	.801:
946	2971.95	702865.38	1	3.1762	.802:
947	2975.09	704352.14	2	3.1794	.804(
948	2978.23	705840.47	3	3.1825	.805(
949	2981.37	707330.37	4	3.1857	.807!
950	2984.51	708821.84	5	3.1888	.809:
951	2987.65	710314.88	6	3.1920	.810:
952	2990.80	711809.50	7	3.1951	.812:
953	2993.94	713305.68	8	3.1982	.813(
954	2997.08	714803.43	9	3.2014	.815(
955	3000.22	716302.76	**1.020**	3.2045	.817!
956	3003.36	717803.66	1	3.2077	.818:
957	3006.50	719306.12	2	3.2108	.820:
958	3009.65	720810.16	3	3.2139	.821(
959	3012.79	722315.77	4	3.2171	.823(
960	3015.93	723822.95	5	3.2202	.825!
961	3019.07	725331.70	6	3.2234	.826:
962	3022.21	726842.02	7	3.2265	.828(
963	3025.35	728353.91	8	3.2297	.830(
964	3028.50	729867.37	9	3.2328	.831(
965	3031.64	731382.40	**1.030**	3.2359	.833!
966	3034.78	732899.01	1	3.2391	.834(
967	3037.92	734417.18	2	3.2422	.836(
968	3041.06	735936.93	3	3.2454	.838!
969	3044.20	737458.24	4	3.2485	.839!
970	3047.34	738981.13	5	3.2516	.841!
971	3050.49	740505.59	6	3.2548	.843(
972	3053.63	742031.62	7	3.2579	.844(
973	3056.77	743559.22	8	3.2611	.846!
974	3059.91	745088.39	9	3.2642	.847(
975	3063.05	746619.13	**1.040**	3.2674	.849!

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches	Circumference	Area Sq. Inches	Diam. Inches	Circumference	Area Sq. Inches
1.041	3.2705	.8511	1.107	3.4778	.9625
2	3.2736	.8528	8	3.4810	.9642
3	3.2768	.8544	9	3.4841	.9660
4	3.2799	.8560	1.110	3.4873	.9677
5	3.2831	.8577	1	3.4904	.9694
6	3.2862	.8593	2	3.4935	.9712
7	3.2892	.8609	3	3.4967	.9729
8	3.2924	.8626	4	3.4998	.9747
9	3.2955	.8643	5	3.5030	.9764
1.050	3.2987	.8659	6	3.5061	.9782
1	3.3018	.8676	7	3.5093	.9799
2	3.3050	.8692	8	3.5124	.9817
3	3.3081	.8709	9	3.5155	.9834
4	3.3112	.8725	1.120	3.5187	.9852
5	3.3144	.8742	1	3.5218	.9870
6	3.3175	.8758	2	3.5250	.9887
7	3.3207	.8775	3	3.5281	.9905
8	3.3238	.8792	4	3.5312	.9923
9	3.3269	.8808	5	3.5344	.9940
1.060	3.3301	.8825	6	3.5375	.9958
1	3.3332	.8841	7	3.5407	.9976
2	3.3364	.8858	8	3.5438	.9993
3	3.3395	.8875	9	3.5470	1.001
4	3.3427	.8891	1.130	3.5501	1.003
5	3.3458	.8908	1	3.5532	1.005
6	3.3489	.8925	2	3.5564	1.006
7	3.3521	.8942	3	3.5595	1.008
8	3.3552	.8958	4	3.5627	1.010
9	3.3584	.8975	5	3.5658	1.012
1.070	3.3616	.8992	6	3.5689	1.014
1	3.3647	.9009	7	3.5721	1.015
2	3.3679	.9026	8	3.5752	1.017
3	3.3710	.9043	9	3.5784	1.019
4	3.3742	.9059	1.140	3.5815	1.021
5	3.3773	.9076	1	3.5847	1.023
6	3.3805	.9093	2	3.5878	1.024
7	3.3836	.9110	3	3.5909	1.026
8	3.3867	.9127	4	3.5947	1.028
9	3.3899	.9144	5	3.5972	1.030
1.080	3.3930	.9161	6	3.6004	1.032
1	3.3962	.9178	7	3.6035	1.033
2	3.3993	.9195	8	3.6066	1.035
3	3.4024	.9212	9	3.6098	1.037
4	3.4056	.9229	1.150	3.6129	1.039
5	3.4087	.9246	1	3.6161	1.040
6	3.4119	.9263	2	3.6192	1.042
7	3.4150	.9280	3	3.6224	1.044
8	3.4182	.9297	4	3.6255	1.046
9	3.4213	.9314	5	3.6286	1.048
1.090	3.4244	.9331	6	3.6318	1.050
1	3.4276	.9348	7	3.6349	1.051
2	3.4307	.9366	8	3.6381	1.053
3	3.4339	.9383	9	3.6412	1.055
4	3.4370	.9400	1.160	3.6443	1.057
5	3.4401	.9417	1	3.6475	1.059
6	3.4433	.9434	2	3.6506	1.060
7	3.4464	.9452	3	3.6538	1.062
8	3.4496	.9469	4	3.6569	1.064
9	3.4527	.9486	5	3.6601	1.066
1.100	3.4558	.9503	6	3.6632	1.068
1	3.4570	.9521	7	3.6663	1.070
2	3.4621	.9538	8	3.6695	1.071
3	3.4653	.9555	9	3.6726	1.073
4	3.4684	.9573	1.170	3.6758	1.075
5	3.4716	.9590	1	3.6789	1.077
6	3.4747	.9607	2	3.6820	1.079

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches	Circum-ference	Area Sq. Inches	Diam. Inches	Circum-ference	Area Sq. Inches
1.173	3.6852	1.081	1.238	3.8893	1.204
4	3.6883	1.082	9	3.8924	1.206
5	3.6915	1.084	1.240	3.8956	1.208
6	3.6946	1.086	1	3.8987	1.210
7	3.6978	1.088	2	3.9019	1.212
8	3.7009	1.090	3	3.9050	1.214
9	3.7040	1.092	4	3.9082	1.215
1.180	3.7072	1.094	5	3.9113	1.217
1	3.7103	1.095	6	3.9144	1.219
2	3.7135	1.097	7	3.9176	1.221
3	3.7165	1.099	8	3.9207	1.223
4	3.7197	1.101	9	3.9239	1.225
5	3.7229	1.103	1.250	3.9270	1.227
6	3.7260	1.105	1	3.9301	1.229
7	3.7292	1.107	2	3.9333	1.231
8	3.7323	1.108	3	3.9364	1.233
9	3.7354	1.110	4	3.9396	1.235
1.190	3.7386	1.112	5	3.9427	1.237
1	3.7417	1.114	6	3.9458	1.239
2	3.7449	1.116	7	3.9490	1.241
3	3.7480	1.118	8	3.9521	1.243
4	3.7516	1.120	9	3.9553	1.245
5	3.7543	1.122	1.260	3.9584	1.247
6	3.7574	1.124	1	3.9615	1.249
7	3.7606	1.125	2	3.9647	1.251
8	3.7637	1.127	3	3.9678	1.253
9	3.7669	1.129	4	3.9710	1.255
1.200	3.7699	1.131	5	3.9741	1.257
1	3.7731	1.134	6	3.9773	1.259
2	3.7762	1.135	7	3.9804	1.261
3	3.7793	1.137	8	3.9835	1.263
4	3.7825	1.139	9	3.9867	1.265
5	3.7856	1.140	1.270	3.9898	1.267
6	3.7888	1.142	1	3.9930	1.269
7	3.7919	1.144	2	3.9961	1.271
8	3.7951	1.146	3	3.9993	1.273
9	3.7982	1.148	4	4.0024	1.275
1.210	3.8013	1.150	5	4.0055	1.277
1	3.8045	1.152	6	4.0087	1.279
2	3.8076	1.154	7	4.0118	1.281
3	3.8108	1.156	8	4.0150	1.283
4	3.8139	1.158	9	4.0181	1.285
5	3.8170	1.159	1.280	4.0212	1.287
6	3.8202	1.161	1	4.0244	1.289
7	3.8233	1.163	2	4.0275	1.291
8	3.8265	1.165	3	4.0307	1.293
9	3.8296	1.167	4	4.0338	1.295
1.220	3.8328	1.169	5	4.0369	1.297
1	3.8359	1.171	6	4.0401	1.299
2	3.8390	1.173	7	4.0432	1.301
3	3.8422	1.175	8	4.0464	1.303
4	3.8453	1.177	9	4.0495	1.305
5	3.8485	1.179	1.290	4.0527	1.307
6	3.8516	1.181	1	4.0558	1.309
7	3.8547	1.182	2	4.0589	1.311
8	3.8579	1.184	3	4.0621	1.313
9	3.8610	1.186	4	4.0652	1.315
1.230	3.8642	1.188	5	4.0684	1.317
1	3.8673	1.190	6	4.0715	1.319
2	3.8705	1.192	7	4.0747	1.321
3	3.8736	1.194	8	4.0778	1.323
4	3.8767	1.196	9	4.0809	1.325
5	3.8799	1.198	1.300	4.0841	1.327
6	3.8830	1.200	1	4.0872	1.329
7	3.8862	1.202	2	4.0904	1.332

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. Inches	Circumference	Area Sq. Inches	Diam. Inches	Circumference	Area Sq. Inches
1.303	4.0935	1.334	1.352	4.2474	1.436
4	4.0966	1.335	3	4.2506	1.438
5	4.0998	1.337	4	4.2537	1.440
6	4.1029	1.340	5	4.2569	1.442
7	4.1061	1.342	6	4.2600	1.444
8	4.1092	1.344	7	4.2632	1.446
9	4.1124	1.364	8	4.2663	1.448
1.310	4.1155	1.348	9	4.2694	1.451
1	4.1186	1.350	1.360	4.2726	1.453
2	4.1218	1.352	1	4.2757	1.455
3	4.1249	1.354	2	4.2789	1.457
4	4.1281	1.356	3	4.2820	1.459
5	4.1312	1.358	4	4.2851	1.461
6	4.1343	1.360	5	4.2883	1.463
7	4.1375	1.362	6	4.2914	1.466
8	4.1406	1.364	7	4.2946	1.468
9	4.1438	1.366	8	4.2977	1.470
1.320	4.1469	1.368	9	4.3009	1.472
1	4.1501	1.371	1.370	4.3040	1.474
2	4.1532	1.373	1	4.3071	1.476
3	4.1563	1.375	2	4.3103	1.478
4	4.1595	1.377	3	4.3134	1.481
5	4.1626	1.379	4	4.3166	1.483
6	4.1658	1.381	5	4.3197	1.485
7	4.1689	1.383	6	4.3228	1.487
8	4.1720	1.385	7	4.3260	1.489
9	4.1752	1.387	8	4.3291	1.491
1.330	4.1783	1.389	9	4.3323	1.493
1	4.1815	1.391	1.380	4.3354	1.496
2	4.1846	1.394	1	4.3385	1.498
3	4.1878	1.396	2	4.3417	1.500
4	4.1909	1.398	3	4.3448	1.502
5	4.1940	1.400	4	4.3480	1.504
6	4.1972	1.402	5	4.3511	1.507
7	4.2003	1.404	6	4.3543	1.509
8	4.2035	1.406	7	4.3574	1.511
9	4.2066	1.408	8	4.3605	1.513
1.340	4.2097	1.410	9	4.3637	1.515
1	4.2129	1.412	1.390	4.3668	1.517
2	4.2160	1.415	1	4.3670	1.520
3	4.2192	1.417	2	4.3731	1.522
4	4.2223	1.419	3	4.3762	1.524
5	4.2255	1.421	4	4.3794	1.526
6	4.2286	1.423	5	4.3825	1.528
7	4.2317	1.425	6	4.3857	1.531
8	4.2349	1.427	7	4.3888	1.533
9	4.2380	1.429	8	4.3920	1.535
1.350	4.2412	1.431	9	4.3951	1.537
1	4.2443	1.434	1.400	4.3982	1.539

Mensuration of Solid Cylinders, Cones, Etc.

Cylinder = Area of one end × length.

Sphere = Diameter ^{3} × 0.5236.

Segment of Sphere = 0.5236 H ($H^2 + 3\ R^2$), where H = height of segment and R = radius of the base of the segment.

Cone or Pyramid = Area of base × ⅓ perpendicular height.

Frustum = ⅓ H $(A + a + \sqrt{A \times a})$. When A and a = Areas of the ends, H = Perpendicular height.

Frustum of Cone = 0.2618 H ($D^2 + d^2 + D.d$). When D and d = the diameters of each end, H = Perpendicular height.

Wedge = Area of base × ½ perpendicular height.

Frustum of Wedge = ½ H $(A + a)$, when A and a = Area at each end, H = Perpendicular height.

RULES FOR CALCULATING AREAS, CIRCUMFERENCE, ETC. OF CIRCLES, HEXAGONS AND OCTAGONS.

To Find the Area:

Multiply sq. of radius by	3.1416	Log.	= 0.49715
Or " " diameter by	0.7854	"	= 1.89509
" " " circumference by	0.07958	"	= 2.90079

To Find the Circumference:

Multiply radius by	6.2832	Log.	= 0.79818
Or " diameter by	3.1416	"	= 0.49715
" " square root of the area by	3.5449	"	= 0.54960

To Find the Diameter:

Multiply radius by	2.00000	Log.	= 0.30103
Or " circumference by	0.31831	"	= 1.50285
" " square root of the area by	1.1284	"	= 0.05246

To Find the Radius:

Multiply diameter by	.50000	Log.	= 1.69897
Or " circumference by	.15915	"	= 1.20183
" " square root of the area by	.56419	"	= 1.75143

To Find Side of an Inscribed Square:

Multiply diameter by	0.7071
Or " circumference by	0.2251
" divide circumference by	4.4428

To Find Side of an Equal Square:

Multiply diameter by	0.8862
Or divide diameter by	1.1284
" multiply circumference by	0.2821
" divide circumference by	3.545

To Find the Area of a Hexagon:

Multiply the square of the distance across by	0.86603	Log.	= 1.93753
Or " the area of the inscribed circle by	1.1027	"	= 0.04244

To Find the Area of an Octagon:

Multiply the square of the distance across by	0.82843	Log.	= 1.91825
Or " the area of the inscribed circle by	1.0548	"	= 0.02316

THE REAL CAUSE OF UNUSUAL CORROSION OF CONDENSER TUBES

Reports of Experts Showing that Corrosion is Due to Electrolytic Action, Caused by Intake of Cinders and Other Foreign Substances

MARINE ENGINEERS and Engineers of Tide Water Power Stations will be interested in the following summary of the reports of various investigators of causes of corrosion of condenser tubes. These experts, without exception, point to intake conditions as the source of this corrosion.

Prof. A. Humbolt Sexton of the University of Glasgow, writing in the Engineering Magazine of November, 1905, states:

"The corrosion of condenser tubes is one of the difficulties which the marine engineer has constantly before his mind, for not only do the failures thus caused give him endless trouble, and put him to considerable expense, but the corrosion takes place in so many ways and seems to be so erratic that it is almost impossible to guard against it, and in the minds of many engineers that is a feeling of uncertainty and insecurity which is far from pleasant.

"The question, however, remains to be answered:

"Why is the action so much more rapid in some cases than in others? Why is it that whilst in some cases condenser tubes will last ten years or more, in others they fail in a few months, or occasionally even in a few weeks?

"Obviously the fault—if fault there be—or at any rate the reason must be in one of two places. It must either be due to something in the nature of the tubes themselves, or to the conditions under which they have been worked. There is no alternative unless we assume some occult cause to explain the apparently erratic behaviour. Each view has its advocates, the former being favored as a rule by engineers who use the tubes, but who are not familiar with the processes of manufacture while the latter is the view taken by the manufacturers. I hold no brief for either side; I have investigated the matter as fully as I have been able, both in the laboratory and by practical examination of cases of failure, and I am quite familiar with the methods by which the tubes

are made, and the processes through which they pass before reaching the engineer who will use them.

"I feel quite certain that the cause of variation in the durability of condenser tubes is not to be found in the chemical composition or physical structure of the metal, nor in any variation in the process of manufacture, nor in anything connected with the tubes; indeed the tube-maker, while keeping to the specific composition and passing the tubes through the usual tests for soundness, could not, if he tried, turn out a tube specially liable to corrosion. This is, of course, not the usual opinion of engineers. They say: 'Here are two steamers working under exactly similar conditions, and whilst in one the tubes have stood well, in the other they have corroded very rapidly; therefore the reason must be in the quality of the tubes.' This dilemma may, however, be put in another way. Here are two steamers fitted with exactly similar tubes selected haphazard out of one large parcel. In the one steamer the tubes have stood well, whilst in the other they have corroded rapidly, therefore there must be a difference in the conditions of working. The latter is certainly the correct view, for there are so many possible variations in the conditions of working that it is impossible to decide when these are uniform.

"I have come to the conclusion that rapid and irregular corrosion as distinguished from that due to normal action of sea water, is almost invariably due to the electrolytic action set up by the contact of particles of substances electro-negative to the brass, probably in most cases carbon. As to the cure for irregular corrosion there is none,—at any rate after it has made progress, but like many diseases if it can't be cured, it can be prevented, and I am strongly of the opinion that it is always preventable."

The same author in his recent work, "The Corrosion and Protection of Metals," further says:

"From what has been said on the action of sea water on brass, it is quite evident that all condenser tubes must be corroded in time, and that the corrosion will always in the first instance be de-zincification, but whether the spongy copper left will remain in the tube or whether it will be removed will depend upon the eroding power of the water.

"'The formation of the holes in a condenser tube at once suggests local electro-chemical action. It is quite certain that it is not due to anything in the brass. Brass condenser tubes

are of uniform composition, and even if they were not, slight variations in the percentage of copper in places would not set up electrolytic action. Nor are there any impurities present that could have this effect. A very large number of samples of condenser tubes, both those which have stood well, and those which have failed quickly, have been examined, but in no case has any foreign matter been found. Owing to the severity of the mechanical process of drawing, only comparatively pure metals can be used.

"If the corrosion is not due to the metal it must be caused by something external to the tube, and the author is convinced that this is always the case, though he knows that this is not the opinion of many marine engineers. The blame being laid on the metals seems to be due to two causes: (1) that it is easier to blame someone else; and (2) that the causes of corrosion are so obscure that it is very difficult to trace them. Two steamers may be working under apparently similar conditions, yet in one the tubes last well, and in the other they fail rapidly, and therefore it is natural to think that the metal is at fault. Against this may be put the similar fact that tubes of exactly the same composition and make may be supplied to two steamers; in one they may stand well, and in the other they may fail rapidly.

"As a matter of fact, there are so many possible differences in the conditions of working, depending on the character of the water used and the care which the engineer takes of his condenser, that one can never say for certain that the conditions under which the tubes have been placed in two steamers are the same.

"The rapid and irregular corrosion of the tubes seems to be always due to the pressure of some foreign substance which can set up electrolytic action, and thus lead to local corrosion.

"It has been suggested that the cause may be fragments of copper scale left inside the tubes by the maker. This, however, is certainly not the case, for copper scale does not set up action on brass.

"The most likely substance is carbon, which, in any form, rapidly starts corrosion. Cinders may easily be drawn in to the condensers. On such a river as the Clyde, cinders, charcoal, and other materials are very common, and may easily be drawn in with the feed water. In one case, indeed, a cinder was actually found embedded in a condenser tube. Very frequently ashes are discharged in such a way that they can be drawn into the condenser.

"It is, of course, impossible to protect condenser tubes by any internal coating and the only method of minimizing corrosion is to work the condenser under the best possible conditions.

"If these conditions were always attended to, there would be fewer cases of mysterious corrosion."

Prof. Sexton's recommendations for the prevention of trouble of this character are as follows:

1st.—The corrosion from the presence of solid particles can take place only if such particles are allowed to rest in the tubes. If the current be strong, therefore, corrosion is little likely to take place, while if it be sluggish, corrosion is very probable. Should a tube become partially stopped for any reason, that tube is specially liable to corrosion. Sluggish circulation is a very common cause of corrosion.

2nd.—The tube must be frequently cleaned, so that any deposit which is formed may be removed. This is of special importance in steamers running in foul rivers which may readily pick up substances which may cause adhesion of objectionable material. As has been pointed out, tubes that had corroded badly are almost always characterized by the presence of a heavy deposit.

3rd.—The tubes should never be left full of water when the steamer is at rest, but should be run dry and perfectly washed out with clean water as soon as the day's work is done. This, too, is of special importance in steamers running on foul rivers when objectionable material may be drawn in, which during the period of rest will settle to the bottom of the tube and form a lodgment from which it will not be displaced when work is resumed, and so corrosion may set up, and once started it will go on rapidly under the deposit formed."

Sir Gerard Muntz, the celebrated member of the well-known firm of Great Britain in a discussion before the Institute of Metals, Volume No. 2, 1909, states:

"As to the nature of the deposits found in the tubes it was ninety-nine times out of a hundred something which had been brought in, and not anything from the tubes themselves. It was generally matter which had been brought in by the circulation water.

"Many cases of corrosion were the result of the flow of the circulating water being too slow to scour away the deposits which were thus allowed to remain in contact with the surface of the tube. Another cause of corrosion was the decomposition of air and gases. This might result from too slow a flow in the circulation, and the consequent overheating of the water, or it might be caused by misplacement, or malformation, of the water intake, whereby the introduction of an excessive quantity of free air was brought about. He had met with cases of this nature where, after several sets of tubes had failed, an alteration of the intake had been made and the trouble had altogether ceased. Of course in such a case they always blamed the manufacturer. He remembered a case in which they had frequent complaints until the Engineer, having made a little examination of the tubes, thought he would try making a change in the intake. The whole trouble then disappeared. It had occurred inside eighteen months and since then the condensers had been running without complaint for several years."

"Corrosion was often due to concentration and evolution of gas owing to roughness and obstruction."

Mr. Weston of the English Admiralty in a discussion before the Institution of Civil Engineers in 1903 said regarding the corrosion of condenser tubes:

"The Admiralty found it was purely local, and only took place occasionally. Mr. Weston thought it was due to an accretion of matter in the tubes, which retained the moisture and set up minute electro-chemical action which gradually pierced the tubes without any reduction in size outside the perforated spots."

Mr. Tomlinson of the Broughton Copper Company, in a discussion before the Institution of Civil Engineers in 1903, said:

"Referring to condenser tubes, sea-going engineers thought nothing of having a few tubes give out occasionally. The trouble arose when a number of tubes gave out almost simultaneously, which he thought showed fairly conclusively, as was often borne out by chemical analysis, that the fault did not lie with the metal, but with the conditions of use."

Again:

"In the laboratory a sample of any brass tube could be pitted through in the course of a few hours or a day with a current of .5 amperes, using an electrolyte containing only compounds of sodium, chlorine, and iron with water, all of which were sometimes found in the condensers of a ship. He submitted a small sample of tube which a pit-hole had been made through in a few hours."

"A set of condenser tubes might last from ten to twenty years; but under bad conditions would fail in as many weeks."

To show what effect stray currents may have we quote Mr. A. Sinclair of Swansea, in a discussion of Mr. E. L. Rhead's paper on "Notes on Some Probable Causes of the Corrosion of Copper and Brass, Institute of Metals, 1909, Volume II.

"One case is of special interest, as it may afford a clue to the cause producing the perforations. An electric lighting station, also generating current for tramway purposes, had two identically similar engines, one driving an alternator, the other a continuous current generator. In the alternating set no trouble has been experienced, whilst in the other the condenser tubes have been repeatedly broken down."

Sir William A. Tilden, F.R.S., in a discussion following the reading of the Report of the Corrosion Committee of the Institute of Metals:

"He thought that a good deal of mischief was done to condenser tubes while vessels were in port and the tubes empty, *i. e.*, when they were lying with a little water extending along the bottom and the air had free access."

Mr. A. E. Seaton, Member of Council (at same meeting)

"He had never known a case where the plates were of cast iron, that the tubes had pitted. The practice of fitting the tubes into tube plates with wooden ferrules, and so insulating them, may have had some effect on their preservation. It is true the iron tube plates become soft, like a piece of plumbago. The most severe case of pitting, that he could recall, occurred in a mill at Grimsby, where the circulating water was sea water obtained from a dead portion of the dock; the water was therefore stagnant sea water. When the owner of the mill spoke about it, Mr. Seaton told him he thought he could supply him with a set of tubes that would be satisfactory. He thereupon deliberately took some old tubes that had been in use in a ship for about ten or fifteen years

and were still perfectly good. He thought that if the tubes had stood that service so long they would keep good at the mill. To be quite sure, however, he had the tubes retinned. Much to his chagrin, they did not last much longer than those previously used, so that he gave up that mill in despair. He now had no doubt that it was the stagnant sea water that caused the severe action on the tubes.

Mr. Arnold Philip, B.Sc., Admiralty Chemist (at the same meeting)

In one instance that had come to his attention, a condenser had broken down seriously, the tubes had been removed and a statistical examination of them had been made. The tubes were marked before they were removed from the condenser, to show which was the bottom and which was the top. In 90 per cent. of the corroded tubes it was found that the corrosion was along a line on the inside bottom surface.

One point came out very strongly in the paper by Admiral Corner, namely: that a real protective effect was produced, by the presence of iron. For instance, in a steel cased condenser no trouble was experienced from corrosion of the brass tubes, and when steel doors were put on to another condenser the same was found to be the case. This struck him as being very valuable evidence, still further accentuated by the fact that directly the steel casing in the first example was coated with lead paint the protection disappeared and corrosion troubles began."

Mr. F. Johnson, M.Sc., Swansea, (at same meeting)

He strongly supported the views of Sir. G. Muntz and the author as to the casting of brass for condenser tubes. With ordinarily careful alloying in the casting shop, not the slightest variation in composition should result. Other causes might possibly contribute to variations in the composition of a casting, *e. g.* incomplete removal of dross, unduly prolonged or accidentally intermittent pouring. In such cases, however, the casting would probably fail in the subsequent drawing operations—an almost infallible test. If tubes had withstood the severe treatment imposed by the modern drawbench, one might safely assume that the caster had performed his share of the work satisfactorily in so far as mixing and clean pouring was concerned.

It is a well established fact that engineers who have observed the precautions suggested by these investigations have had comparatively little trouble from the corrosion of condenser tubes.

The exacting conditions under which "Bridgeport" tubing is made, and its invariable homogeneity, preclude the possibility of unusual corrosion. Such corrosion must be due to conditions of intake or other causes as described.

The result of the foregoing investigations confirm the findings of our own metallurgists and engineers. We have yet to find a single case in which corrosion could be traced to defects of any kind in tubing made by the Bridgeport Brass Company.

Have you ever had Condenser Tubes Crack?

Condenser Tubes made under "Bridgeport" specifications will not crack.

During the past fifteen years—the period of our largest production—we have not received a single complaint of the cracking of any tube made under "Bridgeport" specifications.

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